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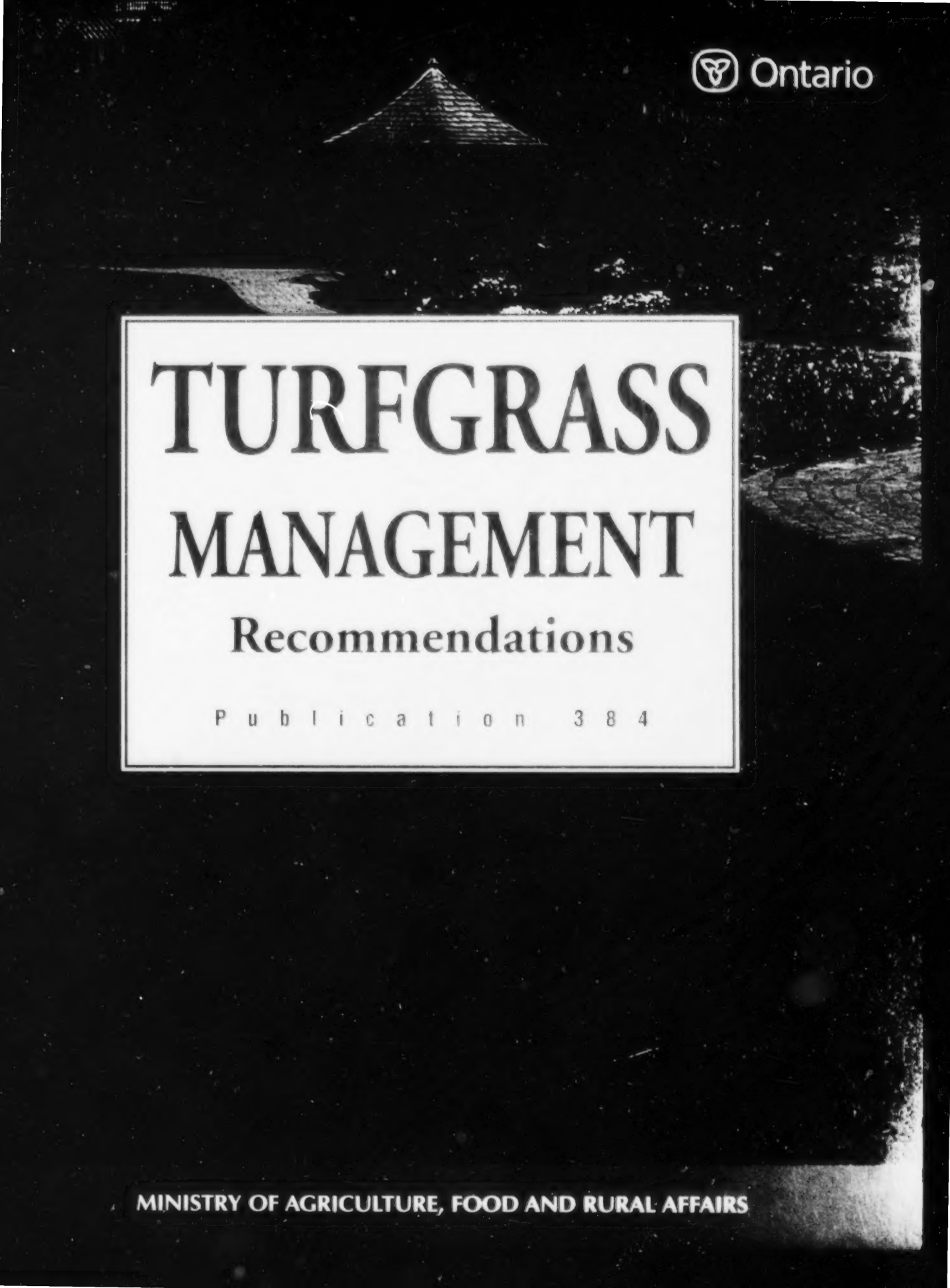


Ontario

TURFGRASS MANAGEMENT

Recommendations

Publication 384

MINISTRY OF AGRICULTURE, FOOD AND RURAL AFFAIRS

Each year the appropriate sub-committee of the Ontario Pest Management Research and Services Committee reviews the pesticides listed in this publication. To the best knowledge of the sub-committee, all of these pesticides were:

- federally registered
- reviewed by the Ontario Pesticides Advisory Committee and
- classified by the Ministry of the Environment as of November, 1999.

Discard old editions of this publication.

The information in this publication is general information only. All pesticides must be used in accordance with the product label and *Regulation 914* of the Ontario *Pesticides Act*.

Pay close attention to all instructions and warnings on the pesticide label.

By printing this publication, the Ministry of Agriculture, Food and Rural Affairs does not offer any warranty or guarantee, nor does it assume any liability for any crop loss, animal loss, health, safety or environmental hazard caused by the use of a pesticide mentioned in this publication.

Policy Statement

In this publication, most recommendations list several pesticides that can be used for each pest discussed. In general:

- the least hazardous materials and those that growers have used satisfactorily for years are listed first;
- the more toxic pesticides and/or newer ones with less practical, grower experience follow.

In some cases, the most effective pesticides are highly toxic.

This publication lists a number of brand names of pesticides. This is for the grower's convenience only. It is neither an endorsement of the product nor a suggestion that similar products are ineffective.

Weather and other factors influence the effectiveness of pesticides and the likelihood of plant injury by control chemicals. Consult the package label and other information regarding compatibility with other materials, the effect of high or low temperatures, poor drying conditions, and so on. Wettable or soluble powders (WP, SP,WDG or DG) are less likely to cause plant injury than liquid concentrates (EC, SC, and F).

Health Canada has established maximum residue limits (MRLs) for pesticides. However, growers should be aware that processors or retailers may demand more restrictive limits. Growers should seek advice of their intended market as to which restrictions or limitations apply.

Federal Registration and Provincial Classification

The Ministry of the Environment administers Ontario's *Pesticides Act* and *Regulation 914*.

All pesticides sold and used in Ontario must be:

- registered under the federal *Pest Control Products Act*, and
- classified under the provincial *Pesticides Act* by being placed in one of six schedules of the Ontario regulation.

Federal Registration

There are three federal registration categories.

1. **Full Registration**
   The federal government agrees the data package was acceptable at the time of registration.

2. **Temporary Registration**
   Additional scientific or technical information is required to obtain full registration. Temporary registrations expire after a specified time (one or two years).

3. **Temporary Registration (Restricted Class)**
   While the pesticide is urgently needed, studies on the safety of the product are incomplete. Such registrations expire on the 31st of December each year and the products must be re-registered yearly.

Provincial Classification

There are six classification schedules in *Regulation 914*. Pesticide products are classified on the basis of their toxicity, environmental or health hazard, persistence of the active ingredient or its metabolites, concentration, and usage. This system is needed to regulate the distribution, availability and use of pesticide products in Ontario.

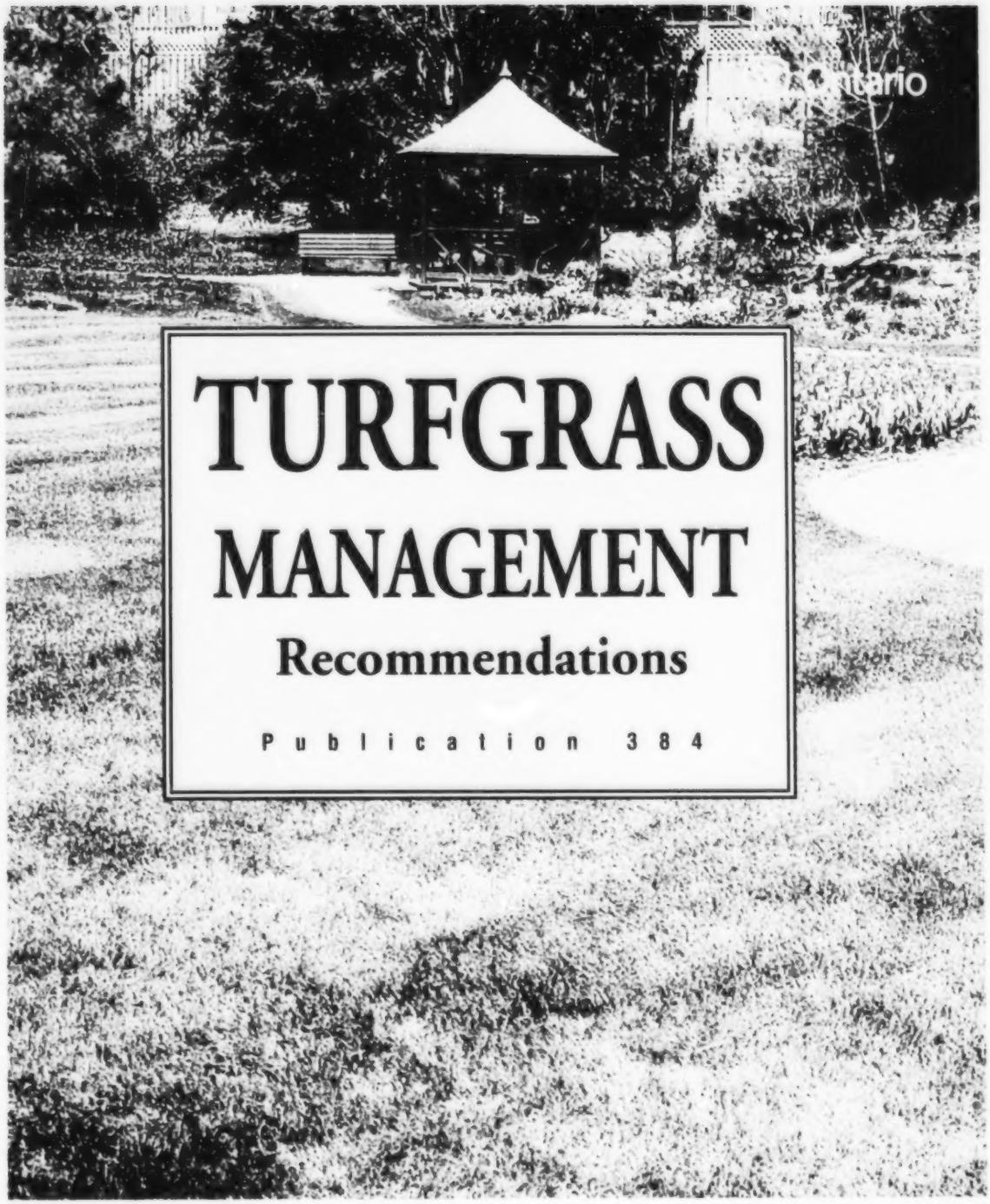
For up-to-date information on the regulatory status of these or other pesticides contact the:

Pesticides Section,
Standards Development Branch,
Ministry of the Environment, Toronto.
Telephone (416) 327-5519

Farmer Certification

Agriculturists must be certified through the Grower Pesticide Safety Course to purchase and use Schedule 1, 2 or 5 pesticides. Effective January 1, 2000 agricultural assistants must complete Ministry of the Environment-approved training before they can handle Schedule 2 or 5 products under the supervision of a Certified Grower. Trained Assistants also have some restrictions of duties. For more information please call the Ontario Pesticide Education Program at 1-800-652-8573.

Cette publication est aussi disponible en français.



TURFGRASS MANAGEMENT

Recommendations

Publication 384

Looking for updates on turf insects, diseases and cultural recommendations?

Phone the OMAFRA Turf Hotline. It's updated every week (April–September) and it's toll free!

1-888-290-4441 (for local calls: 519-826-3414)

Or call us at 1-888-466-2372 to receive it by fax or e-mail subscription.

Looking for turf information on the Internet?

www.gov.on.ca/omafra/english/crops/hort/turf.html

It's one-stop shopping for fact sheets, articles and photos on the production and maintenance of turfgrass.

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1. Pesticide Safety

General precautions

1. Before opening pesticide containers, always read the label and follow all precautions and directions. Keep a record of the common names of all the pesticides you handle, especially those listed as hazardous in this publication. Other members of your family need to know about this list in case there is an accident.

2. Never smoke, chew tobacco or eat while handling or applying pesticides. Do not carry tobacco or food in clothes worn while spraying. Change your clothes and wash before eating.

3. When handling and mixing pesticide concentrates, rinsing empty containers or repairing leaks, wear a full set of protective clothing. This includes a waterproof cap, coveralls, impervious gloves and boots, and safety goggles. If you are using highly or extremely toxic pesticides or very dusty formulations, wear a respirator. If you are handling dusty formulations, wear a dust mask. If you are handling volatiles or gases, you must wear a respirator. If these gases are highly dangerous or you are handling them in an enclosed space, you may need a self-contained breathing apparatus. Make sure you follow the specific instructions on the pesticide label.

4. When you draw water from wells, ponds, streams or other sources, use an anti-backflow device to prevent back-siphoning. Mix pesticide at least 50 m from wells, ponds or streams. Triple or pressure rinse the empty container and add the rinse water to the tank. Only mix enough solution to do the spray job. When you have finished loading and mixing, wash down your gloves and boots with clean water before removing them.

Always read the label and follow the instructions on it.

5. During application, a tractor cab with charcoal filter gives adequate protection against exposure. Wear impervious gloves, boots, coveralls and cap when tending to stoppages. When using airblast and mist blowers or in tractors without cabs, wear waterproof suits and caps and impervious gloves and boots. When applying fumigants in the field, have a respirator on hand in case you need to deal with equipment problems or in case inadequate sealing in the soil allows the fumigant to escape.

6. When the spray operation is done, bathe or shower to remove pesticide deposits on your skin. Do not handle anything in your home before you bathe.

Preventing contamination of farm water supplies

Pesticides can contaminate well, pond and surface water. In fact, it is an offence to contaminate surface waters with pesticides. Taking the following steps will help prevent contamination.

- Keep pesticide concentrates above the flood plain in locked storage.
- After emptying, triple- or pressure-rinse, crush and dispose of containers.
- Return empty plastic or metal containers to a dealer who participates in the container recycling program. Empty bags may be burned or disposed of at a landfill site.
- Mix pesticide and load sprayer at least 50 m away from any water supply.

- Use buffer zones and berms to avoid contaminating surface water, wells, ponds and streams.
- Do not use drinking water sources to fill spray equipment. If you fill your tank from a well, lake, river or other surface water source, you must use an anti-backflow device.
- Do not spray within 10 m of shallow wells or 5–10 m of other water supplies in ideal weather and farther away if there is any air movement. Stop spraying when wind velocity reaches 10 km/hr.

If an accident occurs

1. Wash your gloves, boots, and respirator before removing them. Take off your clothing, including underclothes, immediately and wash contaminated skin thoroughly with soap and water. Soak clothes immediately and double launder them as soon as possible. If the spill was serious, place the clothes in a plastic bag and dispose of them in a safe manner. Wash your gloves, boots and respirator again.

2. If clothing becomes wet with a pesticide, remove it immediately, wash and put on fresh clothes.

If your clothes get wet with a pesticide, remove them — immediately!

3. If symptoms of illness occur during or shortly after handling a pesticide, go to a hospital. Take your list of common-name chemicals with you. (See Emergency Procedures for Pesticide Poisoning on the inside back cover.)

4. Clean up any pesticide spills immediately. In the case of minor spills, use dry soil or other absorbent material such as kitty litter to remove excess liquid. Sweep up powders and granulars. Contaminated soil and sweepings should be spread over a large area of bare soil to facilitate rapid degradation. Make sure you are adequately protected when cleaning up the spill. For information on preventing spills see OMAFRA factsheet, *Ways to Avoid Pesticide Spills*, Order No. 96-025.

In the case of a major pesticide spill, you must notify:

Ministy of the Environment
Spills Action Centre
5775 Yonge St., Suite 1005
North York, Ontario, M2M 4J1

416-325-3000 or 1-800-268-6060.

5. If a well becomes contaminated, follow the clean-up instructions in OMAFRA factsheet, *Pesticide Contamination of Farm Water Supplies*, Order No. 86-077.

See *Emergency procedures for pesticide poisoning and first-aid information* on inside back cover.

Relative toxicity to applicator

Definitions

Lethal dose 50% (LD_{50})
The dose that, when administered, will kill 50% of the test animals within a stated period.

Acute toxicity
Immediate adverse effects from a single or short period of exposure to a substance, either by the oral, dermal or inhalation route.

Chronic toxicity
Adverse effects resulting from repeated exposure to a substance over an extended period.

High acute toxicity
These pesticides are extremely dangerous if handled carelessly. The acute oral LD_{50} is less than 50 mg/kg of body weight, and the acute dermal LD_{50} is less than 200 mg/kg body weight. These pesticides can be fatal if you take less than 0.1 to 3.0 mL (1 drop to half a teaspoon). These pesticides are labelled with the skull and crossbones in a stop sign.

You must use a respirator and eye protection along with all other protective clothing when using these products:

Common name	*Trade name*
azinphos methyl	Guthion, Sniper
carbofuran	Furadan
disulfoton	Di-Syston
endosulfan	Endosulfan, Thiodan
fensulfothion	Dasanit
fonofos	Dyfonate II
methomyl	Lannate
phorate	Thimet
terbufos	Counter
terbufos + phorate	Cygard

Moderate acute toxicity

These pesticides are dangerous if handled carelessly. The acute oral LD_{50} is 50–500 mg/kg of body weight, and the acute dermal LD_{50} is 200–2,000 mg/kg body weight. These pesticides can be fatal if you take 3–30 mL (half a teaspoon to 2 tablespoons). These pesticides are labelled with the skull and crossbones on a stop sign. You should wear a respirator when handling these concentrates:

Common name	*Trade name*
chlorpyrifos	Dursban
deltamethrin	Decis
diazinon	Diazinon, Scotts Insecticide I
dimethoate	Cygon, Lagon
phosmet	Imidan
tefluthrin	Force

Low acute toxicity

These pesticides are not fatal unless deliberately ingested in amounts of over 30 mL (1 oz). The acute oral LD_{50} is greater than 500 mg/kg body weight, and the acute dermal LD_{50} is greater than 2,000 mg/kg body weight. Pesticides listed in this publication and not in the prior lists in this section have low acute toxicities. You should handle them with caution. You must wear protective clothing. You should wear safety goggles, and if using these products in a confined space, you should use a respirator.

Chronic toxicity

It is not possible to assess chronic toxicity of a pesticide in the same way an LD_{50} is used to determine acute toxicity. Instead, a number of tests performed on animals help predict whether a pesticide may cause long-term effects. Animals are examined for a wide variety of toxic effects such as the production of tumors or abnormalities. Using protective clothing and equipment will help reduce exposure and the risk of chronic effects. For more information on pesticide toxicity, see *Table 1-1. Classification of chemicals registered for turfgrass.*

Blood tests

Organophosphorus and carbamate pesticides are capable of inactivating a person's serum and red blood cholinesterase levels. If cholinesterase activity falls below a critical level, poisoning can result. Symptoms include fatigue, dizziness, nausea, trembling, blurred vision and difficulty breathing.

If you use these groups of pesticides, have your family doctor check your cholinesterase levels. To be of value, the tests should be started before you use these pesticides, since the normal level can vary considerably, making it difficult to assess the degree of suppression.

The following insecticides are of primary concern:

Common name	*Trade name*
azinphos-methyl	Guthion, Sniper
carbaryl	Sevin
carbofuran	Furadan
chlorpyrifos	Dursban
diazinon	any formulation containing diazinon
dimethoate	Cygon, Lagon
disulfoton	Di-Syston
fonofos	Dyfonate II
methomyl	Lannate
phosmet	Imidan
phorate	Thimet
terbufos	Counter
terbufos + phorate	Cygard
trichlorfon	Dylox

Protective outdoor clothing

Why use personal protection?

Pesticide formulations vary in toxicity from slightly to extremely poisonous. Exposure occurs once the pesticide is removed from the container. The toxicity of the pesticide and exposure to the user create a hazard. Both can be reduced, toxicity by dilution and exposure by protective clothing. You can reduce the hazards of spraying and thus the risk of poisoning. Wearing protective clothing reduces the risk.

Stage	*Risk level*
Handling and mixing concentrate	very high
Rinsing empty containers	high
Applying outdoors	low–high

Table 1-1. Classification of chemicals registered for turfgrass

Trade name	Common name	LD_{50} (mg ai/kg)[1]	Chemical family
Fungicides			
Aliette WDG	(5) fosetyl-al	2860	aluminum salt
Arrest	(3) carbithiin/oxycarboxin/thiram		anilide
Banner	(2) propiconazole	1310	triazole
Tersan 1991	(3) benomyl	9590	benzimidazole
Truban 30 WP	(3) etridiazole	1077	thiadiazole
Captan	(2) captan	9000	phthalimide
Daconil 2787	(3) chlorothalonil	10000+	aromatic hydrocarbon
Easout	(3) thiophanate-methyl	7000+	benzimidazole
Quintozene	(3) quintozene	1750–2000	aromatic hydrocarbon
Quintozene 75WP	(3) quintozene		
Scotts FFII	(3) quintozene		
Ag-Turf 0-0-6 with 15% quintozene	(3) quintozene		
Turfgo 0-0-6 with 15% quintozene	(3) quintozene		
Turfpride 7-3-12 with 15.4% quintozene	(3) quintozene		
Rovral Green	(3) iprodione	3500	dicarboximide
Safer's De-Moss	soaps		
Terraneb	(3) chloroneb	5000+	chlorinated hydrocarbon
Scotts Granular Fungicide V	(3) chloroneb		
Thiram, Spotrete-F	(3) thiram	780	dithiocarbamate
Insecticides			
Diazinon	(2) diazinon	108	organophosphate
DZN 600EW	(2) diazinon	108	organophosphate
Scotts Insecticide I	(2) diazinon	108	organophosphate
Dursban, Pyrate	(3) chlorpyrifos	135	organophosphate
Chlorpyrifos	(3) chlorpyrifos		
Merit 0.5G, Merit Solupak	(2) imidacloprid	424–475	chloronicotinyl
Sevin XLR Plus	(3) carbaryl	400–850	carbamate
Herbicides			
Acclaim Super	(3) fenoxaprop-ethyl	335	phenoxy-phenoxy
Dycleer	(2) dicamba	1040	benzoic acid
Basagran	(3) bentazon	1100	benzothiadiazine
Betasan	(3) bensulide	770	benzene sulfonamide
Compitox, Mecoprop	(3) mecoprop	930	phenoxy
Dimension	(2) dithopyr	3600	pyridine
2,4-D (many mg.)	(2) 2,4-D 2,4-dichlorophenoxyacetic acid		phenoxy
	(2) 2,4-D/dicamba		phenoxy/benzoic acid
	(2) 2,4-D/dichlorprop		phenoxy/phenoxy
	(3) 2,4-D/mecoprop		phenoxy/phenoxy
	(3) 2,4-D/mecoprop/dicamba		phenoxy/phenoxy/benzoic acid
Gramoxone	(2) paraquat	157–207	bipyridylium
MCPA amines	(3) MCPA	700–1000	phenoxy
Roundup	(3) glyphosate	4320	N-(phosphonomethyl) glycine
Royal MH-60 SG	(3) maleic hydrazide		unique

The numbers in brackets identify the Schedules in which the products are classified under the *Pesticides Act*. 1: restricted to licensed applicator or agriculturist with permit. 2: restricted to licensed applicator or certified agriculturalist. 3: also available to homeowner. 4: unrestricted. 5: agricultural, to be used by licensed applicator with permit or agriculturalist with certificate. 6: similar to 4 but registered for institutional use. For more information, contact a Ministry of the Environment office.

1 The relative toxicity of a pesticide may be referred to as its LD_{50}.

Applying indoors	medium–very high
Cleaning up, rinsing equipment	medium–high
Entering treated area within 48 hours	low–very high

Reducing exposure

Exposure can be through skin, eyes, mouth or nose. About 80% to 85% of the exposure in most spray operations is during mixing and loading concentrate. Field application usually accounts for 15% to 20% of the exposure. Skin exposure is usually 90% to 100% of the total exposure. Around 70% of this is by way of the hands and forearms and 30% involves the rest of the body. Inhalation (nose and mouth) exposure is normally 0.1% but rises to 5% to 10% with mist blowers and air blast sprayers.

Protective clothing

To reduce skin (dermal) exposure, wear impervious gloves. Always refer to the product label. Unless the label says otherwise, use neoprene or nitrile gloves. Always wear waterproof boots, along with coveralls, apron or spray suits and waterproof cap. Coveralls can be reusable or disposable. Reusable coveralls are normally cotton or polyester and should be tightly woven. It's easier for the pesticides to penetrate polyester than cotton.

Disposable coveralls are polyethylene and may be laundered several times. Spray suits should be used in highly hazardous conditions such as with mist blowers and air blast machines. Protect your eyes with safety goggles when working with any pesticide concentrate.

Respirators

Use respirators when handling pesticides with labels that call for respiratory protection and carry the warning stop sign with skull and crossbones. Use respirators when spraying any pesticide rated as high toxicity or when applying any liquified gas. Respirators are available as air purifiers or self-contained units and come in a wide range of shapes and sizes. Consult the label and your nearest safety supply company for advice. Make sure the cartridge or canister you use has a safety-approved sticker with the letters NIOSH (National Institute for Occupational Safety and Health) on it.

Washing protective clothing

To keep your protective clothing and equipment functional, clean it thoroughly. Never let children or pets come in contact with contaminated clothing or equipment. Launder clothing promptly, wash and store other personal protection items and rinse spray equipment and store it away to prevent children from playing with it.

Fabric clothing

If fabric is saturated with the concentrate of a highly toxic pesticide, throw it out. Wear nitrile or neoprene gloves when handling severely contaminated clothing. Remove the clothing carefully and immediately put it in a plastic bag and dispose of it in a safe manner. For a normal spray operation, follow these guidelines, preferably twice a day, but at least at the end of the work day:

- Rinse clothing outdoors.
- Soak and wash protective clothing separately from other clothes.
- Soak protective clothing with detergent in a container such as a large bucket or tub or use the pre-wash cycle of an automatic washer, with detergent. Solvent-based, pre-wash products work on EC pesticide formulations.
- Wash only a few garments at a time.
- Use heavy-duty liquid detergents.
- Use hot water, the highest water level and a regular hot super-wash cycle.
- Do two complete wash cycles, each with a double rinse.
- After washing, run another wash cycle with detergent and no clothing to decontaminate the washing machine.
- Hang the clothes to dry, outside if possible, to avoid a potential build-up of pesticide residue in the dryer.

Rubber, vinyl or plastic boots and gloves

To avoid getting pesticide on your hands, wash the outside of your boots and gloves with detergent and water before taking them off. After removing boots and gloves, wash them inside and out with detergent and water, rinse them thoroughly and dry them in a well-ventilated area.

M121

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Chemical-resistant clothing, goggles and face mask

Wash plastic or rubber clothing and equipment with detergent and water, rinse thoroughly and dry in a well-ventilated area.

Respirators

Discard cartridges, canisters and filter pads when breathing becomes difficult, when you notice a pesticide odour or at the interval set by the manufacturer. Make a note of the date the cartridge is first used. Remove cartridges and filter pads from the face piece and store them in clean, sealed plastic bags. Wash the face piece in detergent and water, rinse it thoroughly and dry it in a well-ventilated area. Never use alcohol or other solvents for cleaning as they will damage the rubber and plastic.

Consult

Consult the safety supply house of your choice for help in selecting your protective clothing. See *Table 1-2. Safety supply companies in Ontario providing protective clothing or respiratory devices.*

Table 1-2. Safety supply companies in Ontario providing protective clothing or respiratory devices

Made by	Available from	Branches	Telephone
E.A.R., AOSafety, Peltor, Eastern	Aearo Canada Ltd. 7115 Tomken Road, Mississauga, Ontario L5S 1X7		(905)795-0700
H.S. Cover Survivair	Levitt-Safety Ltd. 872 Bristol Circle Oakville, Ontario L6H 5T5	Kitchener, London, Oakville, Ottawa, Sarnia, Stoney Creek, Sudbury, Thunder Bay	905-829-3299 888-453-8488
Kasco Helmets	The St. George Co. P.O. Box 430 20 Consolidated Drive Paris, Ontario N3L 3T5		519-442-2046 800-461-4299 www.thest-georgeco.com
Mine Safety Appliances	MSA Canada Inc. 148 Norfinch Drive North York, Ontario M3N 1X8		416-667-9400 800-267-0672
3M Canada Inc. Occupational and Environmental Safety Division	A wide range of distributors, contact: P. O. Box 5757, London, Ontario N6A 4T1		519-451-2500
North	North Safety Products Ltd 26 Dansk Court, Toronto, Ontario M9W 5V8		416-675-2810 800-268-6925
Racal Airstream, Scott, Willson	Acklands-Grainger Inc 90 West Beaver Creek Road, Richmond Hill, Ontario L4B 1E7	Hamilton, Kingston, Kitchener, London, St. Catharines, Sarnia, South Porcupine, Thunder Bay, Windsor	[illegible]0-387-5744
Medical Safety First Aid	Kit Care Corp. 91 Kelfield St, Unit 6, Rexdale, M9W 5A4	Kitchener, London, Orillia, Ottawa, St. Catharines, Stoney Creek	416-243-3030
Many of these companies also have dealer outlets. For details contact the company.			

Protective devices to be used in enclosed areas

Canister gas masks

Canister gas masks are effective for protection against certain harmful gases, vapours and particulate matter. They are generally suitable for ventilated areas not subject to rapid change but should never be used in confined spaces where oxygen deficiency and high gas concentrations may occur.

Self-contained breathing apparatus

Air purifying apparatuses do not work in confined spaces where gas concentrations are unusually high. The lack of oxygen can prove fatal. Under these conditions, you need an air supply provided by a self-contained breathing apparatus (e.g., Scott Air Pack). Using substances that produce hydrogen cyanide, methyl bromide, chloropicrin or phosphine can produce high gas

Chemical-resistant clothing, goggles and face mask

Wash plastic or rubber clothing and equipment with detergent and water, rinse thoroughly and dry in a well-ventilated area.

Respirators

Discard cartridges, canisters and filter pads when breathing becomes difficult, when you notice a pesticide odour or at the interval set by the manufacturer. Make a note of the date the cartridge is first used. Remove cartridges and filter pads from the face piece and store them in clean, sealed plastic bags. Wash the face piece in detergent and water, rinse it thoroughly and dry it in a well-ventilated area. Never use alcohol or other solvents for cleaning as they will damage the rubber and plastic.

Consult

Consult the safety supply house of your choice for help in selecting your protective clothing. See *Table 1-2. Safety supply companies in Ontario providing protective clothing or respiratory devices.*

Table 1-2. Safety supply companies in Ontario providing protective clothing or respiratory devices

Made by	Available from	Branches	Telephone
E.A.R., AOSafety, Peltor, Eastern	Aearo Canada Ltd. 7115 Tomken Road, Mississauga, Ontario L5S 1X7		(905)795-0700
H.S. Cover Survivair	Levitt-Safety Ltd. 872 Bristol Circle Oakville, Ontario L6H 5T5	Kitchener, London, Oakville, Ottawa, Sarnia, Stoney Creek, Sudbury, Thunder Bay	905-829-3299 888-453-8488
Kasco Helmets	The St. George Co. P.O. Box 430 20 Consolidated Drive Paris, Ontario N3L 3T5		519-442-2046 800-461-4299 www.thest-georgeco.com
Mine Safety Appliances	MSA Canada Inc. 148 Norfinch Drive North York, Ontario M3N 1X8		416-667-9400 800-267-0672
3M Canada Inc. Occupational and Environmental Safety Division	A wide range of distributors, contact: P. O. Box 5757, London, Ontario N6A 4T1		519-451-2500
North	North Safety Products Ltd 26 Dansk Court, Toronto, Ontario M9W 5V8		416-675-2810 800-268-6925
Racal Airstream, Scott, Willson	Acklands-Grainger Inc 90 West Beaver Creek Road, Richmond Hill, Ontario L4B 1E7	Hamilton, Kingston, Kitchener, London, St. Catharines, Sarnia, South Porcupine, Thunder Bay, Windsor	800-387-5744
Medical Safety First Aid	Kit Care Corp. 91 Kelfield St. Unit 6, Rexdale, M9W 5A4	Kitchener, London, Orillia, Ottawa, St. Catharines, Stoney Creek	416-243-3030
Many of these companies also have dealer outlets. For details contact the company.			

Protective devices to be used in enclosed areas

Canister gas masks

Canister gas masks are effective for protection against certain harmful gases, vapours and particulate matter. They are generally suitable for ventilated areas not subject to rapid change but should never be used in confined spaces where oxygen deficiency and high gas concentrations may occur.

Self-contained breathing apparatus

Air purifying apparatuses do not work in confined spaces where gas concentrations are unusually high. The lack of oxygen can prove fatal. Under these conditions, you need an air supply provided by a self-contained breathing apparatus (e.g., Scott Air Pack). Using substances that produce hydrogen cyanide, methyl bromide, chloropicrin or phosphine can produce high gas

concentrations and oxygen deficiency as can smoke generators, foggers using highly toxic pesticides and some volatile sprays.

Other protective clothing

Wear other protective clothing in keeping with requirements listed on the pesticide label.

Working conditions

Use canister gas masks when the surrounding air contains low concentrations of toxic gases, vapours or particulate matter derived from soil-drench, granular, dust or foliar spray applications. Pesticides applied in this manner usually have moderate to low toxicity. You must use a self-contained breathing apparatus (e.g., Scott Air Pack) when applying highly toxic pesticides. These can produce high concentrations of toxic gases, vapours or particulate matter, and a lack of oxygen, especially in an enclosed space (e.g., fumigating grain). Contact your safety supply company for their recommendation.

Storing pesticides

The *Ontario Pesticides Act and Regulation 914* require that all pesticides be kept out of the reach of children, irresponsible persons, pets and livestock. They should be stored in a locked facility away from food and feed. Herbicides should be stored separately from other pesticides to avoid contamination.

Always store pesticides in their original containers and keep them tightly closed. Never put pesticides in unmarked containers. In areas where flooding has been frequent, you must store fertilizers and pesticides above the known highwater mark. Contamination of water by these chemicals has led to serious health problems for humans and domestic animals as well as fish and wildlife.

See also OMAFRA factsheet, *Pesticide Handling Facilities*, Order No. 94-037.

Schedule 1, 2 and 5 pesticides

Schedule 1, 2 and 5 pesticides must be stored in a locked facility that is ventilated to the outside. A sign that says **"CHEMICAL STORAGE WARNING— AUTHORIZED PERSONNEL ONLY"** in block capitals must be fixed to the outside of each entrance. Only the certified agriculturalist or someone under that person's supervision can enter the storage facility.

Disposal of pesticide containers or contaminated material

All paper or cardboard pesticide containers, paper packaging material or other paper material used to clean up spills should be burned or disposed of at a landfill site. Make sure that people and animals are kept away from the smoke and that the smoke is not directed toward buildings, highways, roads or outdoor public areas. Plastic material must not be burned.

Unrinsed containers can contain as much as 3% of the original formulation. If this amount of toxic pesticide is discarded with the container it could be dangerous to other people handling it or to the environment (e.g., your water supply). Failure to rinse is also wasteful. Use that 3% for the reason you bought it — to control the pest.

Rinse all metal, plastic or glass containers three times with water and add the washings to the spray tank. Or use a rinsing device. These rinsers can be used to puncture the bottom of a metal or plastic container and rinse the residue directly into the spray tank. This procedure takes less than a minute. Return the rinsed containers for recycling to any dealer cooperating in the pesticide container collection and recycling program.

Dispose of unwanted or contaminated pesticide through Laidlaw Environmental Management (519-451-6630), or contact the appropriate registrant to develop an alternative method acceptable to the director under the *Pesticides Act* (416) 327-5519.

New packaging method available

To simplify disposal of empty pesticide packages, the industry has re-introduced a soluble package that dissolves in the tank of the farm sprayer. Water-soluble packaging under names such as Clean Pak, Solupak and Toss-N-Go is used for dry flowable and wettable powder formulations of pesticides.

In the majority of cases, the water-soluble packaging material is PVA (poly vinyl alcohol). This material dissolves completely when added to the water in the sprayer tank according to instructions.

Handling

- Do not allow water-soluble pouches to get wet before adding them to the sprayer tank.
- Do not handle the pouches with wet hands or wet gloves.
- Do not remove water-soluble pouches from the overwrap (outer package) except when adding them to the sprayer tank.
- Always reseal the outer package to protect the remaining pouches from moisture.

Mixing

- After spray tank is one-quarter full of water and the agitator is running, add the water-soluble pouches to the tank.
- Depending on the water temperature and the degree of agitation, these pouches dissolve completely within five minutes.
- As tank continues to fill, add any other compatible pesticides.

Compatibility

- Do not add a pesticide that is incompatible with the PVA packaging material. The PVA material is not soluble with summer-type oils (e.g., Superior Oil).
- Do not combine with the pouches any material containing boron (e.g., Solubor), chelated micronutrients or water-soluble fertilizers. The combination is likely to cause a sticky, insoluble substance in the tank.
- After applying boron, chelated micronutrients or water-soluble fertilizers, completely empty and rinse the spray tank before using any product packaged in PVA.

Read all labels and instructions carefully. For more details contact your farm chemical dealer.

Sprayers

Herbicide sprayers that can deliver enough litres per hectare for adequate coverage are satisfactory for applying emulsion-type insecticides. However, if 2,4-D or related herbicides have been used in them, the sprayers will have to be cleaned thoroughly or foliage may be damaged. The detergent used should contain ammonia.

For applying the wettable powder formulations, adequate agitation is essential. Pumps should be capable of delivering the flow and pressure required as well as being compatible with materials sprayed. Keep in mind that the higher the pressure, the greater the danger of drift to other crops.

Calibrate your sprayer at least twice during the growing season with each set of nozzles used. The wear on nozzles and other parts will alter the amount of spray delivered. Check all nozzles for flow rate at least once a year. Replace nozzles when their output is 10% greater than rated output. For information on calibration, see the current OMAFRA Publication 75, *Guide to Weed Control*.

Application by plane or helicopter

Aerial applicators must obtain a Commercial Aerial Applicators licence from the Ontario Ministry of the Environment to apply pesticides. In addition, they need permits from the Ontario Ministry of the Environment to apply Schedule 1 and 5 pesticides and Schedule 2 hormone-type herbicides. Ministry personnel will inspect the area to ensure the application is done safely.

It is an offence under the federal *Pest Control Product Act* to use a control product under unsafe conditions. Precautions must be heeded at all times to prevent drift. Extra precautions should be taken when using insecticides applied by air, especially those known to be toxic to honeybees, such as Sevin (carbaryl).

Applications should not be made if the wind is blowing. Even on the calmest day, some drift occurs. To keep it to a minimum, apply pesticides in the evening or early morning.

Be sure that the contract specifies the product to be used and its rate of application. Only products specifically allowing aerial use may be applied by aircraft.

Pesticide drift

Pesticide drift can leave residues on adjacent crops, be a hazard to nearby people and livestock and reduce the amount of material in the target area so

that it is ineffective. People applying pesticides should make every effort to minimize or prevent pesticide spray drift by doing one or more of the following:

- Read the label.
- Be aware of the toxicity of the pesticide being used.
- Use buffer strips around water courses and neighbouring fields.
- Be aware of the weather conditions.
- Use spray plume protection (hoods, shrouds, screens and air curtains).
- Use drift reducing adjuvants.
- Use wick weeders.
- Select the correct nozzle-to-target distance.
- Select the correct water rate.
- Choose the proper nozzle.
- Don't spray if conditions are not suitable.

Growers are responsible for any material discharged from their sprayers no matter where it is found. This includes liability for adverse affects such as damage to crops or to ornamental plants and illegal or unacceptable residue on neighbours' crops or property. You could also be responsible for injury resulting from car accidents caused by windows smeared by spray drift or allergic or asthmatic reactions of bystanders even if they are not on your property. Take all precautions necessary to prevent drift off site that might implicate you in any damaging action.

For more information consult OMAFRA factsheet, *Reducing Pesticide Drift and Crop Damage*, Order No. 88-118; OMAFRA / Agriculture and Agri-Food Canada booklet, *Best Management Practices - Pesticide Storage, Handling and Application;* and the Ridgetown College video, *How to Manage Spray Drift*.

Residues on crops to be harvested, fed or grazed

Some pesticide residues disappear quickly; others persist in poisonous form. When crops with persistent residues are fed to livestock the poisons may accumulate in the body fat and milking cows will excrete them or their metabolic products in the milk. Young calves, heifers and dry cows will store them in body fat and secrete them when they freshen months later. Do not use crop residues treated with Thiodan or Endosulfan for bedding.

To avoid exceeding the residue tolerance for insecticides, herbicides and fungicides
- **do not apply them later than recommended**
- **apply only those registered for the crop and pest**
- **do not apply more than the recommended amount**
- **do not apply more often than recommended.**

When controlling insects do not apply an insecticide later than the recommended number of days from harvest. For example, Malathion 500 EC 2–2.75 L (7 days) indicates that the malathion spray should not be used later than seven days before the beginning of harvest and that no more than 2.75 L of an emulsifiable concentrate formulation containing 50% malathion should be used for one hectare of crop in an application.

Bee poisoning

Honeybees, as well as other bees and insects, are important pollinators of several field crops including alfalfa, canola, clover and trefoil. These pollinators are critical to maximizing seed production. Some crops such as canola and legumes are important sources of honey. These crops, and also corn, are important pollen sources. It is therefore important to refrain from poisoning bees foraging on these crops.

Insecticides are required for insect control. With careful management, you can get good insect control without killing bees. The following are a few points to remember in preventing bee poisoning.

- Do not spray any flowering crop on which bees are foraging. If you must apply insecticides, spray in the early morning or in the evening when bees are not foraging. Bees usually do not forage at temperatures below 13°C.

- If you must apply an insecticide poisonous to bees when they are foraging, notify neighbouring beekeepers so that they can protect their bees.

- Do not apply insecticide on windy days to prevent drift toward any nearby hives.

- Remember that ground applications are generally less hazardous than aircraft applications and there is usually less drift.

- When there is a choice, choose the formulation less hazardous to bees. Dusts are more toxic than sprays. EC formulations are less toxic than WP formulations.

Most organophosphate and carbamate insecticides are highly toxic to bees. Insecticides used in field crop production that are toxic to bees are listed in *Table 1-3. Relative toxicity of insecticides to honeybees.*

Table 1-3. Relative toxicity of insecticides to honeybees

Group 1 – Very toxic **Do not apply to flowering crops or weeds.**	
Trade name	**Common name**
Ambush	permethrin
Diazinon	diazinon
Cygon, Lagon	dimethoate
Guthion	azinphos-methyl
Imidan	phosmet
Lannate	methomyl
Lorsban	chlorpyrifos
Malathion	malathion
Ripcord, Cymbush	cypermethrin
Sniper	azinphos-methyl
Sevin	carbaryl
Group 2 – Moderately toxic **Apply only during late evenings or early morning.***	
Decis	deltamethrin
Dylox	triclorfon
Endosulfan,Thiodan	endosulfan
Group 3 – Relatively non-toxic	
All the fungicides	
*Unusually low temperatures at time of application may cause insecticides to remain toxic up to 20 times longer than during warm weather. High temperatures in the early morning or late evening may extend active foraging by bees.	

Other insecticides listed in this guide can be applied at any time with reasonable safety to bees.

When planning to apply a pesticide, advise local beekeepers so that they can move colonies out of the danger area. The provincial apiarist (OMAFRA, 1 Stone Road West, Guelph ON N1G 4Y2) has a list of beekeepers in your area.

Pesticide concentration

Brands of a pesticide from different companies often have different concentrations of the same chemical. If you use one with a concentration different from that listed in this publication, you will need to adjust the rate of application so that you will be applying the same amount of actual chemical (active ingredient).

Seed treatments

Seed dressings or treatments are poisonous to people and livestock. Do not inhale the fumes or dust when treating or handling treated seed. Wear neoprene or nitrile gloves. Wash all residue of these chemicals from your skin after finishing the treatment. Chemically treated seed is poisonous.

Never feed surplus seed to livestock. Destroy all the bags that have held treated seed as recommended in the container disposal section on page 7.

Pesticide information specific to turfgrass

Pest resistance to insecticides, fungicides and miticides

Many of the recommended pesticides have very specific mechanisms of action , that is, they act on a single system or site in the organism. Do not use these materials continuously or repeatedly in a season. This increases the chances of pest resistance developing. Examples of these types of compounds are Tersan 1991, Easout, Rovral and Banner.

Pests are said to be resistant when they are able to survive exposure to rates of pesticides that previously controlled them.

Generally, resistance to a pesticide develops after repeated exposure to a specific chemical. Resistance occurs because a few naturally occurring resistant individual pests survive after each spray, while the susceptible portion of the population is killed. These resistant survivors multiply and gradually replace the susceptible ones. Eventually only a

resistant population remains, which cannot be controlled by the pesticide.

The development of resistance to pesticides can occur very quickly.

Do not use the same chemical repeatedly. Alternate chemicals with a different chemical or use chemicals in combination with others that have a different mode of action. This practice reduces the likelihood of resistance developing in the pest population.

Please note that several pesticides may act similarly. For example, Tersan 1991 and Easout act on the same site and if resistance develops to one, it is likely to apply also to the other. This is called cross-resistance. Thus, alternating these compounds does not work. They should be alternated with fungicides with different modes of actions, for example, Captan or Daconil.

Pesticide injury to crops

Although insecticides and fungicides are selected and formulated to avoid plant injury, damage can, under some conditions, still occur. In addition to the precautions mentioned in this publication, there are a number of others that should be observed:

- Apply sprays when the drying condition is fast. Some chemicals break down to components that are injurious to plant tissues if they stay wet.
- Apply sprays when the temperature is below 27°C. Be particularly careful when plants have been under growth stress, such as prolonged periods of drought, excessive cloud cover, extremely low or high temperatures.
- Apply sprays soon after mixing. Some chemicals may undergo a chemical change if the sprays remain in the tank for a long time, for example, overnight. In other cases, the chemicals may settle out and clog the lines.

Weed control

While this publication includes recommendations for weed control on turfgrass, see OMAFRA Publication 75, *Guide to Weed Control* for complete weed control recommendations, including comprehensive information on chemicals, safety precautions and calibration and care of sprayers.

Herbicide use precautions

Spray drift can damage or destroy susceptible crops a great distance from the sprayer.

- Use extreme caution when applying hormone-like herbicides (2,4-D, MCPA, etc.) near susceptible plants or crops.
- Only apply these herbicides when it is calm (early morning or late evening) or when a very light wind is blowing away from any susceptible plants.
- Use only enough pressure to get uniform distribution (200-250 kPa). High pressures produce many small droplets that drift.
- Do not use the same sprayer for applying 2,4-D and similar herbicides that you use to apply insecticides and fungicides.
- Drain and wash out the sprayer immediately after use.
- Do not empty herbicide mixtures or wash water into drainage ditches, streams or ponds or places where the herbicides can be washed into them.
- Do not mix different herbicides, or herbicides with other pesticides or foliar fertilizers, unless recommended by competent authorities.

Public notice program under the *Pesticides Act*

Increasingly, the public is demanding to know where and when pesticides will be used, so they can take suitable precautions to avoid exposure. In particular the public wants to know about spraying in publicly accessible areas such as residential lawns, playing fields and parks where children, adults and pets may be exposed.

Amendments to Regulation 914 under the *Pesticides Act* require posting notification of pesticide use in Ontario on public land areas and on residential land areas where pesticides are applied by licensed applicators.

Applicator's responsibility

The applicator must obtain suitable weatherproof signs in accordance with the regulation, and fill them in. The applicator must ensure that

signs are posted 24 hours before application in the case of certain public lands or at the time of application for private residential properties. The applicator must remove the signs on the third day after applying the pesticide. Contact your local Ministry of the Environment offices for more information. Ministry staff are listed on page 41.

New pesticide licensing system

To apply pesticides to public land you must obtain a pesticide licence from the Ministry of Environment. A new pesticide licensing system was phased in on Oct. 1, 1998 which will be fully effective within the next four years. When current licenses expire, operators and vendors will apply for new licenses under the new system. The following summarizes the changes:

- The pesticide licensing system has been restructured and simplified by reducing the number of license categories from 53 to 18.
- The educational component of the pesticide licensing system has been strengthened. Ridgetown College, University of Guelph will deliver the Ontario Pesticide Training and Certification Program for new exterminators.
- Effective January 1, 2000, all unlicensed pesticide applicators must become registered technicians to apply pesticides commercially under indirect supervision. The Pesticide Technician Program is a two-part program consisting of an academic and a practical component. On completion, the candidate receives a pesticide technician card that is valid for two years. For more information contact the Pesticide Industry Council at 1-800-265-5656, ext. 351 or the Pesticide Industry Regulatory Council at 1-800-615-9813.

For more information on regulatory changes call toll free 1-888-620-9999 or visit the ministry web site: *www.ene.gov.on.ca.*

2. Soil Management and Fertilizer Use

Soil testing

Soil testing and plant analysis are currently the most accurate tools available to determine how much fertilizer, lime, phosphorus and potassium to apply to turf areas. Where possible, both methods should be used.

Submit your turf soil samples to a commercial laboratory accredited by OMAFRA for analysis. All analyses are on a fee-for-service basis. The laboratories must meet and maintain established levels of proficiency on the basic tests to keep their accreditation. See Accredited Soil Test Laboratories in Ontario, page 38, for a complete list of accredited laboratories.

Recommendations are made on the basis of four types of turfgrass management programs:

- greens and tees
- fairways, athletic fields and lawns
- nursery sod
- low-use turf.

Soil sampling

The following steps ensure the quality of your sample taken for testing:

- use a soil sampling tube, shovel or a cup changer
- take the core to a depth of 15 cm on all turf except greens and tees
- for greens and tees take a depth of 7.5 cm, which is more closely related to the active root feeding zone of bentgrass
- take at least 20 cores (10–15 on greens) for each sample
- since greens and fields are highly variable, make sure each unit has a separate sample
- sample problem areas separately
- discard the thatch layer of the core, then mix the cores thoroughly in a clean plastic pail
- fill the sample box and fill out an information sheet specifying the type of turf for which you need a recommendation.

When to sample

On well-established turfgrass areas, representative sampling every two to three years may be adequate. On newly established turfgrass areas and on sand root zones, test annually to monitor the nutrient status more closely. Nitrogen and potash levels can change quickly in sand root zones or if clippings are removed.

Soil tests from other laboratories

Each year there are requests to interpret soil test results from other laboratories. Provided the other laboratory uses the identical chemical tests used by the OMAFRA-accredited service and expresses their test results in the same units, the OMAFRA fertilizer requirements for phosphate and potash can be used for interpretation.

However, this is rarely the case.

Only soil tests using chemical extractants that have been calibrated on Ontario soils can provide accurate fertilizer recommendations. A number of laboratories provide tests such as exchange capacity, nitrogen, iron, copper and sulphur. The OMAFRA soil testing service does not do these tests because they do not contribute to better fertilizer recommendations. Research has shown that using exchange capacity to adjust recommendations on Ontario soils can lead to less reliable guidelines than are now provided.

Micronutrient tests

Micronutrient deficiencies in turf are rare.

The OMAFRA service does test for manganese and zinc. No acceptable soil test for copper or boron is available in Ontario. Plant analysis can give some indication of micronutrient status.

With the exception of some areas in northwestern Ontario, there appear to be adequate supplies of sulphur for crop production.

Take great care to prevent contamination of soil samples you are having tested.

- Do not use galvanized (zinc plated) soil sampling tubes to take samples for micronutrient tests.
- Do not use metal containers to collect and mix samples.

Plant analysis

Plant analysis measures the nutrient content of plant tissue. By comparing the analysis results against the "normal" range, you can determine whether nutrient supply is adequate in your turfgrass. See *Table 2-1. Desirable nutrient concentrations in dried turfgrass clippings* for the necessary information.

Plant analysis is a useful supplement to soil testing in evaluating the fertility status of turfgrasses. It is quite independent of soil testing and can provide a valuable second opinion, especially for phosphorus, potassium, magnesium and manganese. It is also the only test for nitrogen and the micronutrients.

Plant analysis has limitations. Expert help in interpreting the results is often needed since plant analysis does not always indicate the cause of the deficiency or the amount of fertilizer required to correct it.

Table 2-1. Desirable nutrient concentrations in dried turfgrass clippings

Element	Normal Range
N	2.5–6.0
P	0.15–0.55 %
K	0.9–4.0%
Ca	0.2–4.5%
Mg	0.15%–1.0%
Mn	20–140 ppm
Zn	10–100 ppm
Cu	5–30 ppm
B	3–30 ppm

This information is provided as a guideline until more information is available. Nutrient levels vary depending on turfgrass species.

Sampling

To collect a proper sample you need about 500 grams of clippings. Take the clippings from the mower baskets.

Do not contaminate the sample with soil. Even a small amount of soil will make the results invalid, especially for manganese. Iron analysis is not likely to be useful because of contamination.

Do not topdress, fertilize or apply any chemical sprays before taking the tissue sample as this contaminates it.

Dry the samples immediately by placing them in a thin layer on a clean surface. Stir the clippings occasionally to help them dry uniformly.

Place them in a sample bag and deliver them to the lab immediately.

A soil sample taken at the same time as the clipping sample will provide additional results for comparison.

Nitrogen

There is no satisfactory soil test available for nitrogen under Ontario conditions.

The amount of nitrogen fertilizer used strongly affects the colour, density and vigour of turf. Adjust the amount of nitrogen for the desired growth response. Use the recommendations in *Table 2-2. Nitrogen requirements for turf and nursery sod* as a guideline.

A common rule of thumb for bentgrass greens during the summer months is to use nitrogen at a rate at which two baskets of clippings are removed per day per 550 m^2. The specific application rate depends on the type of nitrogen carrier used. More frequent applications are required with water soluble carriers and less frequent with slow-release carriers.

Nitrogen equivalency

Fertilizer recommendations are often based on actual (elemental) nitrogen. Use the following

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Table 2-2. Nitrogen requirements for turf and nursery sod

Greens, tees	Nitrogen to be recommended by turf specialist; not more than 400 kg N/ha in 6–8 applications, 250 kg N/ha is usually sufficient for established greens. Not more than 50 kg N/ha per application.*
Lawns, fairways, athletic fields	Nitrogen to be recommended by turf specialist; not more than 200 kg N/ha in 4 applications if clippings are left on. Not more than 50 kg N/ha per application.
Low-use turf	Nitrogen to be recommended by turf specialist; 50 kg N/ha applied once per season.*
Nursery sod	Prior to final cultivation before seed bed preparation and where the soil is a coarse texture, apply 90 kg N/ha. Where the soil is a medium or fine texture, is high in organic matter or has a history of luxuriant growth, reduce the initial application to 50 kg N/ha. On turf with less than 85% groundcover, apply 70 kg N/ha as early as feasible in the spring after seeding. Reduce the rate to 35 kg N/ha where vigorous growth is evident. In mid or late June apply 50 kg N/ha. Withhold further applications until 3 weeks prior to harvesting at which time apply 35 kg N/ha. Where sod is held over a second winter, apply 45 kg N/ha in September, early November, late May and every 10 weeks until harvest.

* Divide kg/ha by 100 to obtain kg/100 m.

calculation to determine the application rate of any nitrogen fertilizer formulation.

To apply 0.5 kg actual N/100m²

$$\frac{100}{\%N \text{ in fertilizer}} \times 0.5 \text{ kg/100m}^2 = \text{kg fertilizer/100m}^2$$

To convert to kg/ha, multiply by 100

Another method is to use *Table 2-3. Nitrogen equivalency table* to determine the amount of fertilizer (with any given per cent nitrogen) required for an application rate of 0.5 kg N/100m².

Table 2-3. Nitrogen equivalency table

To obtain 0.5 kg N/100 m²	
N% in fertilizer	**kg/100m**
5	10.00
6	8.33
7	7.14
8	6.25
9	5.55
10	5.00
11	4.55
12	4.16
13	3.84
14	3.57
15	3.33
16	3.12
17	2.94
18	2.77
19	2.63
20	2.50
21	2.38
22	2.27
23	2.17
24	2.08
25	2.00
26	1.92
27	1.85
28	1.79
29	1.72
30	1.67
31	1.61
32	1.56
33	1.50
34	1.47
35	1.43
46	1.09

Nitrogen Sources

Water-soluble sources of nitrogen fertilizers are generally less expensive. However, they are also more prone to leaching and have a higher burn potential. Therefore, if used, apply these sources of nitrogen more frequently but at lower rates and water them in after application.

Slow-release sources of nitrogen are generally more expensive but less prone to leaching, have a lower burn potential and are available more slowly.

Water-soluble sources

Ammonium nitrate, ammonium sulphate, potassium nitrate, urea.

Table 2-2. Nitrogen requirements for turf and nursery sod

Greens, tees	Nitrogen to be recommended by turf specialist; not more than 400 kg N/ha in 6–8 applications, 250 kg N/ha is usually sufficient for established greens. Not more than 50 kg N/ha per application.*
Lawns, fairways, athletic fields	Nitrogen to be recommended by turf specialist; not more than 200 kg N/ha in 4 applications if clippings are left on. Not more than 50 kg N/ha per application.
Low-use turf	Nitrogen to be recommended by turf specialist; 50 kg N/ha applied once per season.*
Nursery sod	Prior to final cultivation before seed bed preparation and where the soil is a coarse texture, apply 90 kg N/ha. Where the soil is a medium or fine texture, is high in organic matter or has a history of luxuriant growth, reduce the initial application to 50 kg N/ha. On turf with less than 85% groundcover, apply 70 kg N/ha as early as feasible in the spring after seeding. Reduce the rate to 35 kg N/ha where vigorous growth is evident. In mid or late June apply 50 kg N/ha. Withhold further applications until 3 weeks prior to harvesting at which time apply 35 kg N/ha. Where sod is held over a second winter, apply 45 kg N/ha in September, early November, late May and every 10 weeks until harvest.

* Divide kg/ha by 100 to obtain kg/100 m.

calculation to determine the application rate of any nitrogen fertilizer formulation.

To apply 0.5 kg actual N/100m²

$$\frac{100}{\%N \text{ in fertilizer}} \times 0.5 \text{ kg}/100\text{m}^2 = \text{kg fertilizer}/100\text{m}^2$$

To convert to kg/ha, multiply by 100

Another method is to use *Table 2-3. Nitrogen equivalency table* to determine the amount of fertilizer (with any given per cent nitrogen) required for an application rate of 0.5 kg N/100m².

Table 2-3. Nitrogen equivalency table

To obtain 0.5 kg N/100 m²	
N% in fertilizer	**kg/100m**
5	10.00
6	8.33
7	7.14
8	6.25
9	5.55
10	5.00
11	4.55
12	4.16
13	3.84
14	3.57
15	3.33
16	3.12
17	2.94
18	2.77
19	2.63
20	2.50
21	2.38
22	2.27
23	2.17
24	2.08
25	2.00
26	1.92
27	1.85
28	1.79
29	1.72
30	1.67
31	1.61
32	1.56
33	1.50
34	1.47
35	1.43
46	1.09

Nitrogen Sources

Water-soluble sources of nitrogen fertilizers are generally less expensive. However, they are also more prone to leaching and have a higher burn potential. Therefore, if used, apply these sources of nitrogen more frequently but at lower rates and water them in after application.

Slow-release sources of nitrogen are generally more expensive but less prone to leaching, have a lower burn potential and are available more slowly.

Water-soluble sources

Ammonium nitrate, ammonium sulphate, potassium nitrate, urea.

Slow-release sources
Activated sewage sludge, IBDU, urea formaldehyde, methylene urea, sulphur-coated urea and polymer-coated urea.

Phosphorus and potash

Apply phosphorus and potassium (potash) to turf areas based on a soil test. The requirement of these nutrients are presented in *Table 2-4. Phosphorus and potassium requirements for turf and nursery sod*. This table should not be used with soil test readings from other soil testing laboratories unless the methods used are identical to those used by the OMAFRA accredited laboratory. Common sources of phosphorus and potassium can be found in *Table 2-5. Phosphorus sources* and *Table 2-6. Potassium sources*.

Table 2-4. Phosphorus and potassium requirements for turf and nursery sod

Soil phosphorus (0.5 M sodium bicarbonate)	Greens, tees, fairways, lawns, athletic fields	Low-use turf	Nursery sod	Soil potassium (1M amm. acetate)	Greens, tees	Fairways, lawns, athletic fields	Low-use turf	Nursery sod
ppm P	Phosphate (P_2O_5) required — kg/ha*			ppm K	Potash (K_2O) required — kg/ha*			
0–3	370 L	90 L	230 L	0–15	400 L	200 L	90 L	140 L
4–5	360 L	80 L	210 L	16–30	360 L	180 L	80 L	120 L
6–7	350 L	70 L	200 L	31–45	320 L	160 L	70 L	80L
8–9	340 L	60 L	190 L	46–60	280 L	140 L	50 L	60 L
10–12	320 L	40 M	170 L	61–80	200 L	100 L	30 M	50 M
13–15	300 L	30 M	150 L	81–100	160 L	80 M	20 M	40 M
16–20	260 L	20 M	130 M	101–120	120 M	60 M	20 M	30 M
21–25	200 M	0 H	110 M	121–150	80 M	40 M	0 MH	30 M
26–30	170 M	0 H	90 M	151–180	40 M	40 M	0 VH	0 H
31–40	120 M	0 VH	70 H	181–210	0 H	0 H	0 VH	0 VH
41–50	70 H	0 VH	50 H	211–250	0 VH	0 VH	0 VH	0 VH
51–60	40 H	0 VH	40 H	250 +	0 E	0 E	0 E	0 E
61–80	0 VH	0 E	30 H					
80 +	0 E	0 E	0 E					

L = low; M = medium; H = high; VH = very high; E = extremely high
* Above rates are total yearly applications. Not more than 90 kg/ha should be applied in any one application except for nursery sod, which may receive the total yearly amount in one application before seeding.

Phosphorus is important in establishing turfgrasses. Where a soil test is not available, use the following guidelines to obtain a rough estimate of requirements:

- Where the turf has been fertilized regularly for a number of years or heavily in recent years, use the rates of phosphate and potash recommended for the medium soil test rating.
- If the field has received little fertilizer in the past, use one of the rates recommended for a low soil test rating.

Phosphorus does not leach readily from the soil and may accumulate to very high levels. Potash leaches to some degree from sandy and organic soils. In contrast, nitrogen leaches quite readily.

Table 2-5. Phosphorus sources

Source	P_2O_5 %
Superphosphate	20
Triple superphosphate	44 – 46
Monoammonium phosphate (18-46-0)	48 – 52
Diammonium phosphate (21-53-0)	46

Table 2-6. Potassium sources

Source	K_2O %
Potassium chloride (muriate)	60 – 62
Potassium sulphate	50
Sulphate of potash magnesia (11% Mg)	22
Potassium nitrate	44

Applying fertilizer

Turf use, conditions and soil type

Areas that are used and irrigated a lot need more nutrients. Nitrogen and potassium are the most affected. Older turf requires less nitrogen than younger turf. Do not apply more than 0.5 kg actual N/100 m^2 per application (see *Table 2-2. Nitrogen requirements for turf and nursery sod*).

It is better to apply fertilizer more frequently at a lower rate. This is especially true when applying fertilizer in the summer. Granular fertilizer applications on golf course greens of less than 0.125 kg N/100 m^2 could result in uneven coverage and "freckling" of the turf.

Type of fertilizer

Water-soluble or quick-release fertilizer allows the nitrogen to be available to the plant regardless of soil temperature. Examples are urea, ammonium nitrate, ammonium sulphate, potassium nitrate and ammoniated phosphates and IBDU. Where water-soluble ammonium nitrate or urea is used, water it in to avoid foliar burn.

Timing of fertilizer

When to apply nitrogen fertilizer depends on such factors as

- turf species
- turf use
- turf conditions
- soil type
- desired level of quality
- weather conditions
- length of growing season
- whether or not clippings are removed
- type of fertilizer used.

Avoid fertilizing during periods of heat, drought stress or when conditions favour active disease development.

Early spring fertilization is not recommended as this tends to promote excessive shoot growth. Delay applying nitrogen until early June. Applying fertilizer high in nitrogen between October 20 and November 5 generates better root growth, early green-up and moderate growth rates in the spring. Delay applying if fall weather is warmer than normal. For low-use turf that is only fertilized once per year, early fall application is recommended. Rates should be kept sufficiently low to prevent lush growth late in the fall.

Fall fertilization

Early fall is an important season for turf growth and recovery, and nitrogen fertilization is needed to accomplish this. Late fall fertilization also helps turf to overwinter. With the onset of fall temperatures, shoot growth stops but roots will continue to grow and accumulate reserves of carbohydrates. This will allow the plant to store carbohydrates, which helps it to survive the winter and promote early green-up in the spring.

Advantages

Fertilizing turf in the fall offers many advantages:

- increased tiller formation resulting in dense turf that resists weed infestation
- turf that stays green longer in the fall
- increased winter hardiness
- early spring green-up
- no need for early spring fertilizer and no flush of soft spring growth
- delay of first spring fertilizer application until late May or early June.

Timing

Fall fertilization of turf is a two-step process. Timing for the first application is mid-August to mid-September. You should not apply nitrogen from mid-September to late October.

The best time for the second application is when the temperature has steadily lowered to 10°C. The turf is still green, the shoots are no longer growing, the roots are still growing, and it is well before dormancy. Timing of application in the Guelph area is late October to early November.

The timing of the late fall nitrogen application is crucial as the period that produces optimal benefits may only last a couple of weeks. With improper timing, the fertilizer is detrimental or ineffective.

An early application forces succulent growth and tissue hydration, which increase the turf's susceptibility to winter disease and low-temperature kill. An application of nitrogen fertilizer when turf has already gone dormant does not produce the carbohydrates that promote root growth or allow the

plant to produce and store carbohydrates that result in early spring green-up.

Application schedule

Fall fertilization programs should be divided into two parts:

- the first application: 0.3–0.5 kg N/100m² in mid-August to mid-September
- the second: 1–1.5 kg N/100m² in late October to early November with a high-nitrogen, low-potassium fertilizer.

The use of P and K for fall fertilizer application should be determined by a soil test.

Fertilizer selection

See *Table 2-7. Rating of nitrogen sources for suitability for late fall fertilization.*

Table 2-7. Rating of nitrogen sources for suitability for late fall fertilization

	Analysis	Source of N	Suitability for late fall
Quick Release			
Urea	46-0-0	urea	excellent
Ammonium nitrate	33-0-0	AN	excellent
Ammonium sulphate	21-0-0	AS	excellent
Ammonium phosphate	18-46-0	DAP	good
Ul Reaction Products			
Nutralene	40-0-0	methylene ureas	good
Methylene urea	39-0-0	methylene ureas	good
Nitroform (gran.)	38-0-0	ureaform	poor
Natural organics			
Milorganite	6-2-0	activated sludge	poor
Sustane	5-2-4	composted turkey litter	poor–fair
Ringer products	6-1-3	seed & bone meals, blood	poor
IBDU	31-0-0	IBDU	good–excellent
Coated materials			
Sulphur-coated urea with sealant	varies	urea	fair–good

Environmental considerations

Fall fertilization has many advantages, but there are environmental risks. Late fall, winter and early spring bring precipitation that recharges the aquifers. Potential leaching of soluble substances such as nitrate is increased during these periods. It is no longer recommended on highly permeable soils, such as sand, to fertilize late in the fall. In these situations, slow-release sources such as IBDU and sulphur-coated ureas, which prevent leaching of nitrates, should be used.

Sewage sludge in sod production

Sewage sludge is a source of nitrogen, phosphorus and organic matter that can be used to produce sod. A site receiving sewage sludge must have a certificate of approval issued by the Ontario Ministry of the Environment (MOE).

Before sewage sludge can be applied to land it must qualify under the MOE guidelines. These guidelines restrict the types of crops sewage sludge can be used on and the waiting period between applying sewage sludge and harvest.

The waiting period between applying sludge and harvesting commercial sod is 12 months. For more information refer to OMAFRA factsheet *Land Application of Sewage Biosolids for Crop Production*, Order No. 95-069.

Adjusting soil pH

Soil pH is a measure of acidity or alkalinity on a scale from 0 to 14. The middle of the scale (7.0) is neutral, with values below 7.0 being increasingly acid and values above 7.0 increasingly alkaline. Most Ontario soils are between 5.0 and 8.0. As soil acidity increases, the solubility of elements

such as iron and manganese also increases. Most turf species grow well in soil pH 5.5–7.5.

Raising pH

Lime is used to raise pH and is useful where soil pH is low. General lime applications for most crops, based on buffer pH, are listed in *Table 2-8. Lime requirements to correct soil acidity based on soil pH and soil buffer pH.*

Table 2-8. Lime requirements to correct soil acidity based on soil pH and soil buffer pH

Buffer pH	Target soil pH = 6.5 Lime if soil pH < 6.1	Target soil pH = 6.0 Lime if soil pH < 5.6
	Ground limestone required – t/ha (based on Agricultural Index of 75)	
7.0	2	0
6.5	3	2
6.0	9	6
5.5	17	12
5.0	20	20

Buffer pH

Different soils with any one soil pH value, for example 5.2, require different amounts of lime to bring the pH to a particular desired level, e.g., 6.0. This depends chiefly on the clay and organic matter content of each soil.

The soil pH determines which soils need to be limed but a separate soil test, the buffer pH, determines the amount of lime required. For soils needing lime (based on soil pH), use *Table 2-8. Lime requirements to correct soil acidity based on soil pH and soil buffer pH*, to determine the amount of lime needed to reach different target soil pH values required for different crops.

Limestone quality

Calcitic limestone consists largely of calcium carbonate. Dolomitic limestone is a mixture of calcium and magnesium carbonates. Use dolomitic limestone on soils with magnesium soil test of 100 or less as it is an excellent inexpensive source of magnesium for acid soils. On soils with magnesium tests greater than 100, either calcitic or dolomitic limestone may be used to increase soil pH.

Two main factors affect the value of limestone for soil applications. One is the amount of acid a given quantity of limestone will neutralize when it is totally dissolved. This is called the "neutralizing value" and is expressed as a percentage of the neutralizing value of pure calcium carbonate. A limestone that will neutralize 90 per cent as much acid as pure calcium carbonate is said to have a neutralizing value of 90. In general, the higher the calcium and magnesium content of a limestone, the higher the neutralizing value.

The second factor that affects the value of limestone as a neutralizer is the particle size. Limestone rock has much less surface area to react with acid soil than finely powdered limestone. Hence it neutralizes acidity much more slowly — so slowly that it is of little value.

Lowering pH

Sulphur can be used to lower pH. See *Table 2-9. Soil acidification to pH 5.0 with sulphur*. Do not apply more than 2 kg elemental sulphur per 100 m^2 on established turf. Lower rates should be used on high sand content soils, such as putting greens. Soils with pH above 7.0 frequently contain too much lime to use sulphur to lower the pH.

Table 2-9. Soil acidification to pH 5.0 with sulphur

Initial pH	Soil type	
	Sand (kg/100m^2)*	Loam (kg/100 m^2)*
7.0	7.4*	22.6
6.5	6.0	17.5
6.0	4.0	12.0
5.5	2.0	6.0
* kg of elemental sulphur per 100 m^2 for 2 successive years.		

Temperature, moisture and aeration conditions affect the rate of pH change. The best time to apply materials to adjust the pH is spring, late fall or after cultivation practices such as coring. Perform major pH adjustments before your turf is established. This way it will be incorporated into the root zone.

Soluble salts in soil

High concentrations of water-soluble salts in soils can prevent or delay germination of seeds and can kill established plants or seriously retard their growth.

Ontario soils are naturally low in soluble salts. Soluble salts therefore rarely cause a problem in crop production and are not routinely measured in soil tests.

Excessive applications of fertilizers, run-off of salts applied to roads and chemical spills are some reasons soluble salts are found in soils. If the amount of water is small, a given amount of salt in a soil creates a higher soil-water-salt concentration. Soluble salts also interfere with the uptake of water by plants. For these reasons, plant growth is most affected by soluble salts in periods of low moisture supply (during drought periods).

Soluble salts can be measured readily in the laboratory by measuring the electrical conductivity of a soil water slurry. The higher the concentration of water soluble salts, the higher the conductivity. *Table 2-10. Soil conductivity reading interpretations* provides an interpretation of soil conductivity readings in Ontario field soils in a 2:1 water-soil-paste mixture, the procedure used by the OMAFRA accredited laboratories.

Table 2-10. Soil conductivity reading interpretation

Conductivity "salt" reading millisiemens/cm	Rating	Plant Response
0 – 0.25	L	Suitable for most plants if recommended amounts of fertilizer used.
0.26 – 0.45	M	Suitable for most plants if recommended amounts of fertilizer used.
0.46 – 0.70	H	May reduce emergence and cause slight to severe damage to salt-sensitive plants.
0.71 – 1.00	E	May prevent emergence and cause slight to severe damage to most plants
1.00	E	Expected to cause severe damage to most plants.

L =low; M=medium; E=extremely high
For greenhouse soils, the OMAFRA accredited soil test uses a larger sample and measures conductivity on a saturation extract. For greenhouse crops using that method, conductivity readings up to 3.5 millisiemens/cm are acceptable.

For more in depth information of soil management and soil fertility, please refer to OMAFRA Publication 611, *Soil Fertility Handbook.*

3. Insect and Disease Management

Cultural control

Many factors influence the occurrence of insect and disease problems on turf. Damage can be minimized by good cultural practices that encourage vigorous turf growth, producing turf that is less susceptible to insect and disease problems.

Use disease and insect resistant turf species and varieties when possible. Several cultivars of turf-type perennial ryegrass, tall fescue and fine fescue contain endophytes. Endophytes are fungi that grow inside the turfgrass plant. These endophytes give turfgrass some resistance to surface feeding insects such as chinch bugs, bluegrass billbugs, sod webworm and cutworms.

Other elements to an integrated approach to pest control on turf include

- maintaining balanced fertility and soil pH
- avoiding drought stress
- controlling thatch
- proper mowing and irrigating.

Foliar diseases

Foliar diseases can be prevented by reducing the period of leaf wetness. To accomplish this

- water turf during the day rather than at night
- reduce shade conditions
- increase air circulation.

Monitoring

Frequent monitoring for diseases and insects is critical for effective turf pest management. It allows for early detection of the pest problem before extensive damage occurs.

Observe the parts of the plant that are being damaged. Note symptoms that may occur, such as yellowing or browning of leaves, thinning of turf, die-back or wilting, patchy appearance or the presence of insects or visible mycelium. Some disease and insect problems are more prevalent on certain turfgrass species. Knowing the main pest problems of a specific species may help diagnose the problem.

Timing

Proper timing of chemical applications is critical for achieving pest control. Be aware of the season of occurrence, life cycle and damaging stage of the pest. This may influence selection and application of your control method. A summary of turf insect life cycles, damage, etc., can be found in *Table 3-1. Turf insects: Summary of life cycles, habitat, damage and distribution factors*. For more detailed information on turf disease and insect identification and biology refer to OMAFRA Publication 162, *Diseases and Insects of Turfgrass in Ontario*. If you are unable to identify an insect or disease pest, samples can be submitted to the Pest Diagnostic Clinic (see address on page 38).

Lists of insecticides and fungicides registered for use on turf can be found in *Table 3-2. Insect control* and *Table 3-3. Disease control*.

When applying pesticides read the label and follow all safety precautions.

Table 3-1. Turf insects: Summary of life cycles, habitat, damage and distribution factors

	Damaging stage	Overwintering stage	Yearly generations	Usual distribution factors
Soil inhabiting insects (attack roots)				
Black turfgrass ataenius	grub	adult beetle	1–2	Moist soil, closely mowed, bluegrass and bentgrass
White grubs	grub	adult beetle or larva	3-year cycle	Sandy soil
European chafer	grub	larva	1	Throughout southern Ontario
Japanese beetle	grub	larva	1	Niagara Peninsula and Windsor area
Bluegrass billbug	larva	adult weevil	1	Bluegrass
Thatch inhabiting insects (attack leaves and stems)				
Annual bluegrass weevil	larva	adult weevil	1	Annual bluegrass
Hairy chinch bug	nymph, bug	adult bug	1	Excess thatch, non-irrigated turf, high population in fescues
Sod webworms, lawn moths	caterpillar	larva	2–3	
Cutworms	caterpillar	eggs	2	Around aeration holes on moist ,closely mowed turf
European cranefly	larva	larva	1	Niagara Peninsula area
Turfgrass scale	mature nymphs	mature nymphs	1	Kentucky bluegrass, fine fescue, creeping bentgrass. Sodded lawns 3–5 years old

Table 3-2. Insect control

Pest	Control	Rate/100 m^2	**Use enough water for thorough coverage. Follow label instructions.**
Annual bluegrass weevil, Hyperodes weevil (*Hyperodes maculicollis*)	Dursban 2E Dursban Turf Pyrate 480 EC	90 mL 45 mL 45 mL	Mainly a problem on closely mowed turf composed mainly of annual bluegrass. Spray suspected areas in mid-April and again in mid–May or as recommended.
Ant	diazinon 500 EC diazinon 5 G DZN 600 EW Sevin XLR Plus Dursban 2E Dursban Turf Pyrate 480 EC Chlorpyrifos 1G	75–150 mL 0.75–1.5 kg 125 mL 210–290 mL 45 mL 23 mL 22.5 mL 1.0 kg	Repeat in 7–10 days if necessary. Do not water for 2 days after application. Spot treatment on ant hills is usually effective.
Cutworm (various species)	Sevin XLR Plus Dursban 2E Dursban Turf Pyrate 480 EC Chlorpyrifos 1G	210–290 mL 45 mL 22.5 mL 22.5 mL 1.0 kg	Repeat in 7–10 days if necessary. Apply to turf. Do not mow turf 1–3 days after treatment. Spray when cutworms first appear and repeat as needed. Treat in early morning or early evening.
European chafer (*Rhizotrogus majalis*)	Sevin XLR Plus Dursban 2E Dursban Turf Pyrate 480 EC Chlorpyrifos 1G diazinon 500 EC diazinon 5G DZN 600 EW	210–290 mL 90 mL 45 mL 45 mL 2.0 kg 150 mL 1.5 kg 125 mL	Apply when grubs are young and actively feeding near the soil surface in late July to mid–September or as recommended. Remove thatch if excessive. Immediately after spraying irrigate the treated areas with 1– 2 cm of water to wash product into soil. Control is required if 5–10 grubs per 0.1 m^2 on non–irrigated turf or more than 20 grubs per 0.1 m^2 on irrigated turf are observed.
	Merit 0.5G and Merit Solupak	670 g 1 packet/1000m^2*	For optimum control, make application prior to egg hatch. Irrigation or rainfall should occur within 24 hours of application to move the active ingredient through the thatch. On golf courses, irrigate treated areas following application. Avoid mowing turf or lawn areas until after irrigation or rainfall has occurred so that uniformity of application will not be affected. Apply Merit insecticide only once per year.

Table 3-2. Insect control

Pest	Control	Rate/100 m^2	Use enough water for thorough coverage. Follow label instructions.
European crane fly larvae (leatherjackets) *(Tipula paludosa)*	Sevin XLR Plus	200 mL	Monitor turf for abundance of larvae. Consider treatment at densities> 270 larvae/m^2. Apply to late instar larvae. If soil is dry, remove thatch and irrigate 24 hours before treatment. Mow golf course turf and apply spray. Do not water for 2 days after treatment.
	Dursban Turf Pyrate 480 EC	20–25 mL 20–25 mL	Apply as drenching spray in water in late fall after the flight of adult crane flies has stopped.
	diazinon 5G	.75 kg	Apply in late fall while still mild or during first mild spring weather. Soil should not be frozen. Sprinkle lawn 15–20 minutes after applying.
	diazinon 500 EC	75 mL	Treat between early October and late May when soil is not frozen. Water lawn thoroughly after application.
Japanese beetle *(Popillia japonica)*	Sevin XLR Plus Dursban 2E Dursban Turf Pyrate 480 EC Chlorpyrifos 1G diazinon 500 EC diazinon 5G DZN 600 EW	210–290 mL 90 mL 45 mL 45 mL 2.0 kg 150 mL 1.5 kg 125 mL	See remarks for European chafer.
	Merit 0.5G and Merit Solupack	670 g 1 packet/1000m^2*	See remarks for European chafer.
Hairy chinch bug *(Blissus leucopterus hirtus)*	Sevin XLR Plus diazinon 500 EC diazinon 5G DZN 600 EW Dursban 2E Dursban Turf Pyrate 480 EC Chlorpyrifos 1G Scotts Insecticide One	210–290 mL 90–150 mL 0.975–2.0 kg 75–150 mL 45 mL 23 mL 22.5 mL 1.0 kg 1.57 kg	The smaller stages of chinch bug nymphs are easier to control. If damage was significant the previous year, apply when damage or large numbers of chinch bugs are noticed. For best results the lawn should be moist at time of treatment. Do not water for 2 days after application.
Sod webworm, lawn moths *(Pediasia sp.)*	Sevin XLR Plus Dursban 2E Dursban Turf Pyrate 480 EC Chlorpyrifos 1G Scotts Insecticide One diazinon 500 EC diazinon 5 G	210–290 mL 45 mL 22.5 mL 22.5 m 1.0 kg 1.57 kg 75–150 mL 0.975–2.0 kg	Do not water for 2 days after application. Do not mow turf for 1–3 days after treatment. Treat in early morning or early evening. Approximately six or more caterpillars per 0 .1 m^2 (1 sq. ft.) is a level requiring control.
White grub	Dursban 2E Dursban Turf Pyrate 480 EC Chlorpyrifos 1G Scotts Insecticide One diazinon 500 EC diazinon 5G DZN 600 EW	90 mL 45 mL 45 mL 2.0 kg 1.57 kg 150 mL 1.5 kg 125 mL	Apply to turf. Water into soil after treatment. Approximately 3–5 grubs per 0.1 m^2 (1 sq ft) on non-irrigated turf is a level requiring control.

* Rate per 1000m^2

Table 3-3. Disease control

Disease	Control	Rate per 100 m^2	Use enough water for thorough coverage. Follow label directions.
Algae			Improve fertility and drainage. Alleviate compaction.
Anthracnose (*Colletotrichum graminicola*)	Daconil 2787F *Banner 130 EC	170–190 mL 31–62 mL	Occurs June to September under humid and warm conditions. Avoid nitrogen deficiency and drought stress, soil compaction and excessive thatch, especially on annual bluegrass.
Brown patch, Rhizoctonia blight (*Rhizoctonia solani*) Cool weather brown patch, yellow patch (*Rhizoctonia cerealis*)	Daconil 2787 F Rovral Green *Tersan 1991 50 WP *Easout 70 WP *Banner 130 EC Thiram 80 WP Spotrete–F	95–190 mL 120–240 mL 60 g 30–60 g 62–124 mL 90 g 175 mL	Brown patch occurs under humid, warm conditions and extended periods of leaf wetness in June to September. Cool weather brown patch occurs during April to May and September to November. Apply preventive control at 1–2 week intervals when conditions favour disease development. Avoid excess nitrogen and night watering. Use higher rate and shorter interval under severe pressure.
Dollar spot (*Sclerotinia homoeocarpa*)	Daconil 2787F Rovral Green *Tersan 1991 50 WP *Easout 70 WP Thiram 80 WP Spotrete–F *Banner 130 EC	95–190 mL 60 mL 30 g 25–30 g 90 g 175 mL 31–62 mL	Occurs June to October. Avoid nitrogen deficiency, drought stress and night watering. Remove dew. Light frequent application of foliar-applied nitrogen will decrease the severity of dollar spot.
Fairy ring	Chemical control is not practical. Symptoms may be masked by maintaining moderate fertility levels, thorough watering and repeated deep cultivation of the affected area.		
Fusarium patch (*Microdochium nivale*)	Scotts FF II Ag–Turf 0–0–6 with 15% quintozene Turfgo 0–0–6 with 15% quintozene Daconil 2787 F Rovral Green *Tersan 1991 *Banner 130 EC	1.55 kg 1.5 kg 1.5–1.6 kg 370–450 mL 240–360 mL 60 g 62–124 mL	Occurs during cool, wet weather.
Grey snow mould Typhula blight (*Typhula spp.*)	Scotts FF II Ag–Turf 0–0–6 with 15% quintozene Turfgo 0–0–6 with 15% quintozene Turf Pride 7–3–12 with 15.4% quintozene Quintozene 75WP Arrest 75 W Daconil 2787 F Rovral Green Terraneb SP Scotts Fungicide V *Banner 130 EC Spotrete F	1.55 kg 1.5 kg 1.5–1.6 kg 1.5 kg 250 g 250 g 250–500 mL 360 mL 175–275 g 1.45 kg 248 mL 375 mL	For products containing quintozene, a slight discolouration of turf may occur following application. This is temporary. On mixtures containing bentgrass and on putting greens and tees containing bentgrass, limit application to mid–fall through early winter. If the temperature is 27°C or above, water lightly to wash granules off foliage. Control with a single application late in fall before permanent snow cover —early-to-late November in southern Ontario, mid-to-late October in northern Ontario. Avoid succulent turf growth in late fall. Keep turf mowed until leaf growth ceases. Use snow fencing or other methods to prevent excessive snow accumulation. Minimize thatch as this is a perfect environment for dormant sclerotia.
Helminthosporium leaf spot/Melting Out (*Drechslera spp.*)	Daconil 2787 F Rovral Green *Banner 130 EC7 Thiram 80 WP	95–190 mL 120 mL 62–124 mL 125 g	Occurs April to June. For preventive control, spray 2 or 3 times 1–2 weeks apart, beginning when first spots appear. Avoid applications of early spring nitrogen as lush growth and cool wet conditions result in increased disease susceptibility. If disease occurs remove clippings and increase mowing height to reduce severity.
Low temperature *Basidiomycetes*	Arrest 75 W	250–375 g	Winter diseases requiring snow cover for activity. See remarks for grey snow mould.

Table 3-3. Disease control

Disease	Control	Rate per 100 m^2	Use enough water for thorough coverage. Follow label directions.
Pink snow mould (*Microdochium nivale*)	Scotts FFII Ag–turf 0–0–6 with 15% quintozene Turfgo 0–0–6 with 15% quintozene Turf Pride 7–3–12 with 15.4% quintozene Quintozene 75WP Arrest 75 W Daconil 2787 *Tersan 1991 50 WP *Rovral Green *Easout 70 WP *Banner 130 EC	3.10 kg 1.5 kg 1.5–1.6 kg 1.5 kg 250 g 250–375 g 460–700 mL 125 g 240–360 mL 125–175 g 248 mL	Apply late in fall before snow cover. For products containing quintozene, a slight discolouration of turf may occur following application. This is temporary. On mixtures containing bentgrass and on putting greens and tees containing bentgrass, limit application to mid–fall through early winter. If the temperature is above 27°C, water lightly to wash granules off foliage.
Powdery mildew (*Erysiphe graminis*)	*Easout 70 WP	125–250 g	Avoid excess nitrogen and shade. Spray when symptoms appear. Repeat in 2 weeks if needed.
Pythium blight, cottony blight, greasy spot (*Pythium aphanidermatum*)	Terraneb SP Scotts Fungicide V	125 g 1.45–2.9 kg	Occurs June to September under warm, humid conditions. Avoid excess nitrogen and watering. Use preventive control during periods of high temperature and high humidity. Repeat in 5–7 days if conditions remain favourable for disease.
	*Aliette WDG	200 g	Restricted to one application per season. Apply when symptoms appear. Use as part of a season-long spray program with other registered pesticides.
Pythium crown and root rot (many *Pythium spp.*)	Truban	190 g	Maximum of 2 applications per year. Apply when symptoms first appear and again after 7–10 days. Used for golf course greens and commercial turfgrass production.
	*Aliette WDG	200 g	Restricted to one application per season. Apply when symptoms appear. Use as part of a season-long spray program with other registered pesticides.
Moss	Safer's De–Moss	32 mL/L water	Moss problems are commonly associated with low fertility, poor drainage, soil compaction, heavy shade, poor air circulation and poorly adapted grasses.
Necrotic ring spot (*Leptosphaeria korrae*)	"Frog-eye" symptoms visible all year. No chemical control available. Reduce excess thatch. Attacks Kentucky bluegrass and fine fescues. Turf-type perennial ryegrasses and some Kentucky bluegrass varieties are resistant. Provide balanced fertility. Avoid drought stress.		
Red thread (*Laetisaria fuciformis*)	*Banner 130 EC	62 mL	Occurs October to November with cool, wet conditions. Avoid nitrogen deficiency, especially on perennial ryegrass and fine fescues.
Rust (*Puccinia spp.*)	Use resistant varieties of Kentucky bluegrass and perennial ryegrass. No chemical control available. Provide adequate levels of fertility. Mow frequently.		
Slime Molds	No chemical control. Remove spore masses by raking or hosing off the turf.		
Summer patch (*Magnaporthe poae*)	*Banner 130 EC	124 mL	Symptoms usually occur July to August. Attacks annual bluegrass and Kentucky bluegrass. Avoid nitrogen deficiency. Apply light frequent watering during dry periods to reduce heat stress. Apply on a preventive basis. The first application should be when the soil temperature is greater than 16°C at a 5 cm depth for 4 consecutive days, with a second application 30 days later. A third application may be required if hot, humid weather occurs. Apply Banner with 13–21 L of water per 100 m^2.
Take–all patch (*Gaeummannomyces*)	No chemical control available. Attacks bentgrasses. Symptoms visible throughout growing season. Use acidifying (ammonium) fertilizers to reduce thatch pH. Avoid drought stress.		

* Systemic. Alternate or tank mix with one of the other products listed to minimize potential of fungicide resistance developing.

4. Weed Management Lawns, Parks, Golf Courses and Sod Farms

Cultural control

The major species of broadleaf weeds infesting lawns in Ontario are

- dandelion
- plantain
- black medick
- chickweed
- prostrate knotweed
- mallow
- henbit
- ground-ivy and
- white clover.

The major grassy weeds are:

- crabgrass
- annual bluegrass
- quackgrass
- orchardgrass and
- bentgrass.

The easiest, cheapest and most effortless way to keep lawn areas free of weeds is to encourage vigorous growth of turfgrass. Most weeds cannot compete with a dense, healthy turf. Growth practices that encourage vigorous grass growth discourage weed infestations.

Such practices include proper irrigation and drainage, use of fertilizers, insect and disease control and use of the correct type of turfgrass for the situation.

Mowing

Mowing stimulates bud development and tillering, inducing the sod to become thick and dense. Commonly grown grasses, such as the fescues, bluegrasses and turf-type perennial ryegrasses, should be cut at a height of 4–6 cm. Invasion by weeds may occur if grasses are cut shorter than this.

Avoid scalping the turf when cutting around trees and flower beds. Do not remove more than one-third of the leaf area when mowing. Mowing too frequently may reduce the carbohydrate reserves of the turf. This reduces its competitiveness. Mowing can also be used to remove annual weeds and eliminate seed production, reducing or preventing the spread of weeds.

Fertilizer

Fertilizer is particularly important in establishing a thick, dense, and healthy turf sward. Too few nutrients applied to the turf leads to increased susceptibility to disease and insects. If this happens the root system of the turf does not develop. The grass is then unable to withstand traffic or recover from injury. Too much fertilizer may lead to soft, weak grass that is prone to disease damage.

Watering

Watering is critical during periods of drought that may injure, kill or induce dormancy in the turf, allowing weeds to establish. Irrigate weekly, using 3 cm of water per application to help produce deep-rooted turf.

Frequent light sprinkling has the opposite effect on the grass roots. Light water applications encourage the germination and growth of shallow-rooted species such as crabgrass and creeping bentgrass. Too much irrigation water leads to infestations by yellow nutsedge and annual bluegrass.

It is important to install adequate drainage to ensure waterlogging does not occur. Remember to provide adequate watering near trees and hedges because they compete for available moisture.

Compaction

Knotweed and annual bluegrass often invade turfgrass where compaction, caused by excessive

traffic, is a problem. While aeration practices do help, the best solution is to modify the area to reduce traffic. Immediate resodding or reseeding of damaged areas discourages weed infestations.

Turfgrass species

Using the best turfgrass species for a given situation is very important. For example, fescues are tolerant to low-light intensity in shaded areas under trees, whereas turf-type perennial ryegrass varieties are quick to establish in newly seeded areas and will crowd out germinating weeds. Kentucky bluegrass, although slow to establish, is very competitive once established. For more information on species see page 32.

Provided weed populations are not too high, weeds can be removed by hand pulling or with a knife or V-shaped spudding tool.

Chemical control

Chemical weed control is often the easiest, most effective and cheapest way to control annual and perennial weeds when populations are very high. The chemical 2,4-D is most effective in the spring or in September when the weeds are growing well. The treatment generally thins clover in lawns. Mecoprop, dichlorprop and dicamba control a number of weeds not normally controlled by 2,4-D.

Table 4-1. Classification of weeds according to response to various foliage sprays contains information on the response of common weeds to various herbicides. As with 2,4-D, it is important to wet the weed foliage thoroughly. Mecoprop, dichlorprop and dicamba are also sold in mixtures with 2,4-D. Mecoprop is safer to use on bentgrass than 2,4-D.

Table 4-1. Classification of weeds according to response to various foliage sprays

Common name	2,4-D	MCPB	2,4-D or MCPA	Mecoprop	Dicamba
aster (P)	I				
bedstraw (P)	R	I-R	R	I	R
bellflower (P)	R				
bindweed, field (P)	I	I	I	I	S-I
blueweed (B)	S-I	I		I	I
bracken fern (P)	R	R	R	R	I
buckwheat, wild (A)	I-R	I	I-R	I-R	S
burdock (B)	S	S	I		S
buttercup (P)	I-R	S-I	I**(I-R)	I	I
campion, bladder (P)	R	R	R	R	
carrot, wild (B)	S-R	S-R	R	I-R	S
catchfly, night-flowering (A)	R	R	R	R	
catnip (P)	S-I				
chickweed, common (A)	I-R	I	R	S	S
chickweed, mouse-eared (P)	I-R	I-R	R	S	S
chicory (P)	S	S-I	S-I*(R)	I-R	S
cinquefoil, rough (WA)	I				
cinquefoil, sulphur (upright c.), (P)	I				
cocklebur (A)	S	S	S	S	S
cockle, purple (A)	I-R	R	R		I
cockle, white (P)	R		I-R		I
daisy, oxeye (P)	I	I	R	I	I
dandelion (P)	S	S	I*(R)	I	S
dock (P)	I	I	I	I	
evening primrose (B)	S				
false flax (WA)	S	S	S	S	S
fleabane, annual (daily f.) (WA)	I	I	S-I		
fleabane, Canada (A)	S-I				
goat's beard (B)	I				
goldenrod (P)	I	R	I	I	
goosefoot (A)	S	S	S	S	
goutweed (P)	R	R	R	R	
grasses (A and P)	R	R	R	R	
ground ivy (creeping Charlie) (P)	I-R	I-R		I	S
groundsel (A)	I	I			

Table 4-1. Classification of weeds according to response to various foliage sprays

Common name	2,4-D	MCPB	2,4-D or MCPA	Mecoprop	Dicamba
hawkweed (P)	I-R	I-R			S-I
heal-all (P)	I-R	I-R	I-R	S	S
hemp nettle (A)	R	S-I	I-R**(R)	R	
horse nettle (P)	R				I
horsetail (P)	I-R	S-I	I-R	I-R	I
knapweeds (P)	R				I
knotweed (A)	I-R		I*(I-R)	S-I	S
lady's thumb (A)	S-I	I-R	I-R*(R)	I-R	S
lamb's quarters (A)	S	S	S	S	S
lettuce, prickly (A)	S-I	S	S	S	
mallow, round-leaved (P)	I-R	I-R	I-R	I-R	
mayweed (A)	I-R		R		S
medick, black (WA)	I	I	I	S	I
milkweed (P)	R	R	R	I-R	I-R
motherwort (P)	S-I				
mullein (B)	I-R				
mustards (A)	S	S	I	S	
nightshade (P)	I-R			R	
parsnip, wild (B)	S				
peppergrass, common (WA)	S	S-I	I		
peppergrass, field (WA)	S	S	I		
pigweeds (A)	S	I	S-I	S	S
pineapple weed (A)	S		R	R	
plantains (P)	S	S	S-I	S-I	I
purslane (A)	I	I	S-I	S-I	
ragweed (A)	S	S	S	S	S
ragwort (B and P)	I-R	R	R	I	S-I
ribgrass (P) (see plantains)					
rocket, yellow (B)	S	I	I*(R)		
sheperd's purse (WA)	S-I	S	S-I	S-I	
smartweed, green (A)	S-I	I-R	I-R	I-R	S
sorrel, sheep (P)	I	R			
sow thistle, annual (A)	S	I	S-I	I	
sow thistle, perennial (P)	I	R	S-I*(I-R)		S-I
speedwells (A and P)	I-R	I-R		S-I	S-I
spurge, cypress (P)	I-R	I-R	I-R		I
spurge, leafy (P)	I-R	I-R	I-R	R	I
spurry, corn (A)	R	I	R	I	S
St. John's wort (P)	R	R	R	R	R
stinkweed (pennycress) (WA)	S	S	S-I	S	S
stonecrop, mossy (P)	I	I		S-I	
teasel (B)	S				
thistle, bull (B)	S	S	S	S	
thistle, Canada (P)	I	I	I	I	S-I
thistle, nodding (B)	I		I		
thistle, Russian (A)	S-I		I-R	R	S-I
toadflax (P)	R	R	R	R	
velvetleaf (A)	S-I	I	S-I*(I-R)		S-I
vetch (P)	I-R	I-R	R	I-R	I
vetches, wild (A)	S	S			
violet, field (field pansy) (A)	R			R	
water hemlock (P)	S-I				
wood sorrel (P)	I-R				
yarrow (P)	R	I-R		I-R	I-R

A – annual; WA – winter annual; B – biennial; P – perennial; S – susceptible, i.e. killed by one application of 2,4-D MCPA or Mecoprop (1.2 kg or less per ha) or by one application of Dicamba (425 g or less per ha); I – intermediate, i.e. killed less rapidly but controlled by higher rates or repeated applications; R – resistant, i.e. not or only slightly damaged by chemical treatment. Control is not practical with herbicides listed; S-I –between susceptible and intermediate; I-R — between intermediate and resistant

* 2,4-DB more effective (susceptibility to MCPB in brackets)

** MCPB more effective (susceptibility to 2,4-DB in brackets)

Do not use mixtures containing dicamba close to shrubs or other susceptible ornamentals, at rates above 425 g (active) per hectare. Prepared mixtures of this chemical and 2,4-D are effective on a wide range of lawn weed species, including knotweed, which is not controlled by most other herbicides except when very young.

After seeding new turf, many annual weeds may emerge before the grass seedlings are up. If these young weeds are not controlled they will shade and eventually crowd out much of the grass population. Mowing at a height 6–8 cm eliminates many such weeds. If they are extremely thick, 2,4-D at one half of the usual concentration (1.1 kg in 800 L water/ha) or mecoprop (1.1 kg in 400 L water/ha) can be used, but not before the grass has been up at least 4 weeks.

Herbicide control

Broadleaf herbicides

2,4-D controls many broadleaf weeds including dandelion, lamb's quarters, mustards, peppergrass, pigweeds, plantains, shepherd's purse, smartweed and vetch.

Mecoprop controls many 2,4-D and MCPA tolerant weeds such as chickweeds, clovers, ground ivy and black medick. Dicamba controls broadleaf weeds including 2,4-D-tolerant weeds such as chickweeds, clover and young knotweed but does not adequately control plantain. MCPA controls field horsetail, dandelion, lamb's quarters, mustards, plantains, shepherd's purse and wild carrot. Weeds resistant to MCPA include chickweeds, clovers and black medick. Two and three-way mixes of these herbicides extend the spectrum of weeds that are controlled by only one of these herbicides.

DO NOT irrigate, rake or mow until at least 24 hours after application.

DO NOT apply to newly seeded lawns until after second mowing.

See *Table 4-2. Broadleaf herbicides*, *Table 4-3. Grass herbicides*, and *Table 4-4. Emerged yellow nutsedge herbicide* for lists of herbicides registered for use with turfgrass.

Table 4-2. Broadleaf herbicides

Active ingredient	Trade name and (formulation g/L)	Active rate kg/ha	Product rate L/ha	Product rate L/ac	Apply in 200–400L/ha (80–160L/ac) water. Avoid contact with ornamentals, flowers. Avoid applying during hot, dry weather.
2,4-D	2,4-D (470)	0.8–1.4	1.7–3	0.68–1.2	Damage may occur when applied to bentgrass. If used on bentgrass apply at 0.28 kg/ha. Some yellowing may occur.
dicamba	Dycleer (480)	0.6	1.25	0.5	Do not apply to bentgrass at 0.6 kg/ha but may be applied at lower doses or when mixed at low doses with phenoxy herbicides. Do not apply near shallow-rooted perennials as dicamba can be taken up by the roots. Pure dicamba recommended for use in certain situations only. Best when mixed at low-use rates with phenoxy herbicides.
MCPA	Estemine MCPA (500)	1.1–1.4	2.2–2.8	0.88–1.12	Do not apply to bentgrass unless necessary, and then only at 0.28 kg/ha. Some yellowing of bentgrass may occur. MCPA can be used as a substitute for 2,4-D. At slightly higher doses than 2,4-D usually provides as good weed control as 2,4-D. Control of dandelion and plantain may not be as good as with 2,4-D during dry, hot weather.
mecoprop	Compitox (150) Mecoprop (150)	0.8–1.3	5.5–8. 5.5–8.5	2.2–3.4 2.2–3.4	May be applied to bentgrass. Apply before flower to dandelion. Repeated applications may be needed for complete control of dandelion and black medick.

Table 4-2. Broadleaf herbicides

Active ingredient	Trade name and (formulation g/L)	Active rate kg/ha	Product rate L/ha	Product rate L/ac	Apply in 200–400L/ha (80–160L/ac) water. Avoid contact with ornamentals, flowers. Avoid applying during hot, dry weather.
2,4-D/ mecoprop	2,4-D (470) plus mecoprop	0.85–1.1	1.81–2.34	0.72–0.93	Damage may occur when applied to bentgrass. Provides broader spectrum weed control than 2,4-D or mecoprop applied alone. May be combined with Dycleer (0.21 L/ha (0.08 L/ac) to control young knotweed.
	Mecoprop (150)	0.85–1.1	5.67–7.34	2.27–2.93	
	Mecoturf Plus 2,4-D ([1:1] 400)	1.7–2.2	4.25–5.5	1.7–2.2	
	Premium 2-way Herbicide ([1:1] 400)	2	5	2	
	Mecoprop plus 2,4-D ([0.9:1] 194)	2.135	11	4.4	
	Expedite Broad-leaf ([1:2] 186)	1.8–2.6	9.5–14	3.8–5.6	Expedite Broadleaf herbicides are ready-to-use products that must be applied with the Expedite Application System.
2,4-D/ dicamba/ mecoprop	Killex (308)	1.7	5.5	2.2	In closely mowed bentgrass (greens) can be used only at half-doses (30 mL/100 m^2). Temporary yellowing may occur. Recovery from injury occurs 1 week after application (see precautions under dicamba).
	Premium 3-way (308)	1.7	5.5	2.2	
	PAR III (308)	1.7	5.5	2.2	
	Trillion Liquid Turf Herbicides	1.7	6.0	2.4	

Table 4-3. Grass herbicides

Active ingredient	Trade name and (formulation g/L)	Active rate kg/ha	Product rate kg/ha	Product rate L/ac	Apply in 800–1000 L/ha (320-400 L/ac) water
bensulide	Betasan (480)	11–16.6	23–34.6	9.2–13.8	Apply before crabgrass emergence in early spring or in fall to established turf. Use the higher rate for fall application only if no re-seeding has been done in the fall.
	Betasan (12.5)		88–132	35.2–52.8 kg	
dithiopyr	Dimension (120)	0.4 - 0.5	3.5 - 4.5	1.4–1.8	Apply in established turf before crabgrass emergence or early post-emergence when crabgrass is in the 1–3-leaf stage in 200–888 L/ha (80–160 L/ac) water. Use the low rate for pre-emergence applications. For control of crabgrass and many broadleaf weeds, dithiopyr may be tank mixed with broadleaf herbicides.
fenoxaprop ethyl	Acclaim Super (80.5)	0.92	1.14	0.46	Apply post-emergent for the control of crabgrass at 1-leaf to 4-leaf plus 3 tiller. Multi-tillered or heading grassy weeds may be sprayed, and will provide a good result if adequate coverage is attained. A second application may be needed on mature monostands 21 days after first application. Do not apply to bentgrass or seedling Kentucky bluegrass. Do not tank mix with any other herbicide or pesticide. Do not spray a broadleaf herbicide 7 days before or 7 days after an application of Acclaim. Do not spray during periods of drought stress as poor control and possibly damage to desirable turf species may occur. Repeated treatments are required. Reseeding the area will not be possible for one year after treatment.

Table 4-4. Emerged yellow nutsedge herbicide

Active ingredient	Trade name and (formulation g/L)	Active rate kg/ha	Product rate/ha	Product rate L/ac	Apply in 800–1000 L/ha (320-400 L/ac) water
bentazon	Basagran (480) plus Assist oil concentrate	0.84	1.75 2	0.7 0.8	Top growth of nutsedge is controlled by 2 applications 10 days apart.

Turfgrass renovation

Mow and rake thoroughly all turf to be renovated. This removes dead and cut vegetation.

See *Table 4-5. Turfgrass renovation.*

Table 4-5. Turfgrass renovation

Active ingredient	Trade name and (formulation g/L)	Active rate kg/ha	Product rate L/ha	Product rate L/ac	Remarks
paraquat	Gramoxone (200)	2 kg/ha	10 L/ha	4	Apply Gramoxone in 1000 L/ha (400 L/ac) water. This treatment will "burn off" all emerged vegetation. When the old turf is dead, rotovate top 5 cm to cover dead grass, rake the surface to prepare seedbed and reseed.
glyphosate	Roundup (356) Glyfos (360) Expedite Grass and Weed (147)	1.7–2.5	4.75–7 4.75–7 11.5–17	1.96–2.8 1.9–2.8 4.6–6.8	Apply Roundup in 200 to 300 L/ha (80–120 L/ac) water or Expedite Grass and Weed after omitting at least 1 regular mowing. Tillage should be delayed 7 days after application to allow proper translocation into underground plant parts. Direct seeding into the killed turf (no tillage) may be carried out.

Turfgrass establishment

To establish turfgrass in areas that are heavily infested with weeds such as quackgrass, treat with glyphosate (Roundup) before preparing the seedbed. See *Table 4-6. Turfgrass establishment.*

Table 4-6. Turfgrass establishment

Active ingredient	Trade name and (formulation g/L)	Active rate kg/ha	Product rate L/ha	Product rate L/ac	Remarks
glyphosate	Roundup (356) Glyfos (360) Expedite Grass and Weed (147)	1.7–2.5	4.75–7 4.75–7 11.5–17	1.9–2.8 1.9–2.8 4.6–6.8	Use in 200–300 L/ha (80–120 L/ac) water applied post-emergence when quackgrass is actively growing and has at least 4 leaves. Allow 7 or more days after application before tillage. For maximum quackgrass control, a repeat treatment may be necessary before grass establishment. If retreatment is necessary, wait until quackgrass has reached the 3-4 leaf stage. For other perennial weeds, follow label instructions for proper rate and stage of growth.

Retardation

To reduce grass growth treat with maleic hydrazide (Royal MH 60 SG, 6.5–8.0 kg/ha product). Follow the manufacturer's directions carefully. This chemical is recommended for areas where mowing and trimming are difficult and where a lawn-like appearance is not necessary.

5. Turfgrass Species and Varieties

Turfgrass species choices

Many turfgrass species are available for use in Ontario. Your choice depends on the desired appearance, intended use, level of maintenance and site conditions. A summary of turf species based on intended use is shown in *Table 5-1. Turfgrass selection.*

Table 5-1. Turfgrass selection

	Species
Lawns (sun)	
Moderate to high performance	Kentucky bluegrass, turf-type perennial ryegrass
Low maintenance, dry	fine fescues
Lawns (Shade)	
Dry	fine fescue blend or suitable mixture with perennial ryegrasses and shade-tolerant Kentucky bluegrasses
Wet	rough bluegrass
Athletic Fields	
New fields	Kentucky bluegrass blends or Kentucky bluegrass–perennial ryegrass mixture
Overseeding	Turf-type perennial ryegrasses
Golf Courses	
Greens	Creeping bentgrass, fine fescues (at establishment)
Tees	Creeping bentgrass, Kentucky bluegrass, turf-type perennial ryegrass
Fairways	Creeping bentgrass, Kentucky bluegrass, fine fescues

Kentucky bluegrass (*Poa pratensis*)

Kentucky bluegrasses are used extensively for turf areas such as home lawns, sports fields, parks and sod farms. This species produces a high quality, dark green, dense turf with low growth habit of medium to fine texture. Most varieties of Kentucky bluegrasses have good cold tolerance, good recuperative potential from turf injury, good tolerance to traffic and resistance to diseases such as leaf spot.

Kentucky bluegrasses adapt to a wide range of soil and management conditions but prefer moderate fertility, well drained soil and full sun.

Although not very drought resistant, Kentucky bluegrasses can survive long, dry periods in a dormant state.

Canada bluegrass (*Poa compressa*)

Canada bluegrass may be used in areas that are too dry, acidic or infertile for other lawngrasses. It does not recover well from mowing but produces a thin, low-quality turf for low-maintenance areas. It is well adapted to all cool season areas but is not recommended for a high-quality lawn.

Rough bluegrass (*Poa trivialis*)

Rough bluegrass is a fine-textured turfgrass best suited for areas that tend to stay moist and shady, though it is often a component of seed mixes. Seeded areas germinate rapidly, and the grass blends well with other common lawn species. It has poor high temperature and drought tolerance, and its yellowish green leaf blades turn

brown under the stress of high temperature in summer.

Supina bluegrass *(Poa supina)*

Poa supina was selected in Germany in the 1960s. It is currently used there on lawns, sports fields and golf courses. It is a shade-tolerant and wear-tolerant species that can tolerate low mowing height. It performs poorly under hot, dry conditions. It is very agressive and is recommended for the goal mouth areas of sports fields and shaded areas on greens in the United States. It is marketed in seed mixtures with perennial ryegrass, fine fescue and Kentucky bluegrass for use on sports fields and golf courses. *Poa supina* is currently being tested in Ontario.

Weeping alkaligrass *(Puccinellia distans)*

Weeping alkaligrass is a low-growing bunch-type grass with excellent tolerance of alkaline soils. It is both drought-tolerant and winterhardy and looks similar to fine fescue. Weeping alkaligrass establishes rapidly but does not compete well on fertile soils. It is especially suited to areas where road salt kills the existing turf species. Weeping alkaligrass is also well suited for areas where effluent or reclaimed water is used.

Fine fescue (creeping red fescue, chewings fescue, hard fescue) *(Festuca spp.)*

Fine fescues produce a fine-textured turf that is medium green in colour and of low-growth habit. These species grow well under low-moisture and low-maintenance conditions. Most varieties perform well in moderate shade.

Varieties containing endophytic fungi have exhibited increased resistance to many common turf insects including bluegrass billbug, sod webworms and chinch bugs, therefore offering an alternative to chemical insect control. Endophyte-enhanced varieties may also exhibit increased tolerance of stress conditions.

Turf-type perennial ryegrass *(Lolium perenne)*

Turf-type perennial ryegrasses are being used more often for home lawns, sports fields and tees on golf courses. Perennial ryegrass is a wear-tolerant, bunch-type grass with a rapid growth rate. It does not form thatch. Improved turf-type perennial ryegrass cultivars are medium-textured and medium-to-dark green in colour. One of the most significant improvements in turf-type perennial ryegrass cultivars is the incorporation of endophytes (beneficial fungi that live inside the turfgrass plant). Endophytes provide the grass with resistance to leaf-feeding insects such as bluegrass billbug, sod webworm and hairy chinch bugs.

Perennial ryegrass is very quick to germinate and establish. Establishment can take as little as 4–6 days at temperatures of 15–18°C. Because of this, perennial ryegrass is the preferred species for overseeding lawns and sports fields. It requires moderate fertility, tolerates moderate salinity and grows well in sunny to partially shady locations. It is seldom planted alone and is commonly used in seed mixtures to provide a rapid turf cover, acting as a nurse grass for the more slowly germinating Kentucky bluegrass and fine fescues. However, ryegrass should not comprise more than 20%–25% of the seed blend (on a seed weight basis) or its rapid germination and growth cause excessive competition for the other species in the mixture. Perennial ryegrass can be seeded on its own to provide a high-quality sports turf. Because perennial ryegrass does not have rhizomes, frequent overseeding is needed to maintain a dense stand of turf.

Perennial ryegrass has the poorest low-temperature tolerance of all the perennial cool season turfgrasses. It is not winter hardy in all areas of Ontario. It does not tolerate poorly drained soils where standing water may occur in the spring and is best suited to the southern part of Ontario.

Creeping bentgrass *(Agrostis palustris)*

Creeping bentgrass produces a fine-textured, high-quality turf but requires intensive maintenance, including close, frequent mowing and good disease management. It is one of the most cold-hardy turfgrasses. It grows best in full sun but tolerates partial shade, and it has poor drought tolerance, requiring frequent irrigation during dry weather. Creeping bentgrass has a medium establishment rate and low-to-medium nitrogen requirements. It is very tolerant of close mowing and can become very thatchy under a

high-maintenance regime. Creeping bentgrass is susceptible to a wide range of diseases including dollar spot, brown patch, Pythium blight and take-all patch.

Creeping bentgrass is most commonly used for putting and lawn bowling greens where a uniform playing surface is needed. Creeping bentgrass also provides an excellent turf for golf course tees and fairways if mowed at or less than 1.2 cm. One disadvantage is its susceptibility to diseases such as dollar spot.

Colonial bentgrass
(Agrostis tenuis)

Colonial bentgrass can be used as an alternative to creeping bentgrass.

Tall fescue
(Festuca arundinacea)

This is a medium-to-coarse-textured turf species that is tolerant of heat, drought, shade and salt. It is suitable for a wide range of soils and requires low-to-moderate fertility. It is best when seeded on its own.

It is currently being evaluated in Ontario for use on sports fields and along highways and boulevards.

Many tall fescue varieties contain endophytes. Consult the seed supplier for more information.

For more information on turf species see *Table 5-2. Turfgrass species characteristics.*

Table 5-2. Turfgrass species characteristics

Characteristic	Kentucky bluegrass	Perennial ryegrass	Red fescue	Chewings fescue	Hard fescue	Sheep fescue	Tall fescue	Creeping bentgrass
Mowing frequency	M	H	L	L	L	L	H	H
Establishment rate	21 days	4–6 days	13–15 days	M	S–M	S–M	Quite good	M
N required*	0.2–0.7	0.2.–0.5	0.1–0.3	0.1–0.3	L but >sheep	0	0.2–0.5	L–M
Wear tolerance	G	E	F	F	G	G	G	G
Drought tolerance	G	VG	G	G	E	E	E	P
Water usage	H	M	M	L	L	best if not irrigated	H	M
Competitiveness	M	H	M	H	M	M	M	H
Thatch formation	M–H	none	L–M	M–H	M	M	none	H
Shade tolerance	F–G	F–G	VG	VG	VG	VG	G	F
Cold tolerance	VG	P	G	G	G	G	F	E
Seeding rate**	1.0–1.5	2.5	2.0	2.0	2.0–2.5	2.0–2.5	3.0–4.0	0.3–0.5

H=high; M=medium; L=low; E=excellent; VG=very good; G=good; F=fair; P=poor
* kg/100m^2 per growing month
**kg/100m^2

To find out where to buy seed, see *Table 5-3. Grass seed available in Ontario*, page 35.

Table 5-3. Grass seed available in Ontario

Species	Company							
	AgriBioTech Canada	Bishop	Corland	Graham	Ontario	Pickseed	Scotts	Speare
Creeping bluegrass	Peterson's Creeping Bluegrass							
Kentucky blue	1757	Abby	Baron	Absolute	Award	Alpine	Abbey	Abbey
	Apollo	Ascot	Goldrush	Adelphi	Goldrush	America	Ascot	Ascott
	Baron	Bluemoon	Liberator	Arcadia	Liberator	Banff	Bristol	Bluemoon
	Belmont	Freedom II	Liberty	Argyle	NuBlue	Bronco	Buckingham	Cobalt
	Caliber	Goldrush	Regent	Award	Nustar	Crest	Coventry	Dellwood
	Chateau	Impact	Shamrock	Baron	Rambo	Indigo	Victa	Freedom II
	Eagleton	Liberator		Blue-Chip	Regent	Langara	Envicta	Georgetown
	Freedom II	Minnfine		Cannon	Shamrock	Limousine		Goldrush
	Georgetown	Rambo		Fairfax		Marquis		Liberator
	Haga	Rugby II		Impact		Quantum Leap		Nassau
	Huntington	Shamrock		Kenblue		Touchdown		Ram I
	Impact			NuGlade				Rambo
	Liberty			Rambo				Shamrock
	Nassau			Regent				
	Nottingham			SR2100				
	Odyssey			Total Eclipse				
	Preakness							
	Princeton 105							
	Ram I							
	Sebring							
	Total Eclipse							
	Welcome							
Ryegrass	Affinity*	Academy*	Academy*	Caddieshack*	Academy*	Cutter*	Achiever*	Academy*
	Atlantis*	Archer*	Elf*	Champion Blend*	Archer*	Edge*	Ascend*	Accent*
	Ice*	Elf*	Monterey*	Goalkeeper*	Devine*	Express*	Divine*	Archer*
	Imagine*			SR4000*	Elf*	Fiesta II*	Majesty*	Elf*
	Lynx*			SR4010*	Envy*	Fiesta III*		Envy*
	Palmer II*			SL4100*	Nighthawk*	Futura 3000*		Monterey*
	Palmer III*			SR4200*	Omega III*	Lowgrow*		Omega III*
	Phantom*			SR4300*	Seville*	Sunshine*		Prizm*
	Prelude II*			SR4400*	Top Gun*			Saturn*
	Prelude III*							Seville**
	Quest*							Sovereign*
	Repell II*							Top Hat*
	Repell III*							
	Secretariat*							
	Stallion Select*							
	Stallion Supreme*							
	Yorktown III*							

Table 5-3. Grass seed available in Ontario

Species	Company							
	AgriBioTech Canada	**Bishop**	**Corland**	**Graham**	**Ontario**	**Pickseed**	**Scotts**	**Speare**
Fescue: Creeping red	Eugene*	Florentine*	Vista	SR5200 E*	Fenway*	Boreal	Common	Florentine*
	Flyer II*			Cindy	Franklin	Jasper	Fenway*	Franklin
	Trapeze *			Hectar	Jasper			Vista
					Vista			
					Cindy*			
					Florentine*			
Fescue: Chewings	Culumbra*	Sandpiper*	Koket	SR5100*	Cascade	Victory II*	Banner II*	K2
	Dignity*		Southport	SR5000*	K2		Dignity	Sandpiper*
	Jamestown II*			Sandpiper*	Koket		Molinda	Southport*
	Wilma				Southport*		K2	Treazure*
					Treazure*			Wilma
Fescue: Hard	Eureka	Brigade	Nordic*	SR3100*	Nordic*	Spartan	Brigade	Brigade
	Reliant II		Serra*	SR3000*	Reliant*		Attila	Nordic*
	Saxon			Osprey	Serra*			Reliant*
Fescue: Sheeps	Azure	MX86	MX86	MX 86	MX86	Azay		Azure
								MX86
Fescue: Tall	Empress*	Arid III*	Empress*	SR8200*	Arid III*	Crossfire*	Adobe*	Arid III*
	Finelawn Petite*	Pedestal*	Jaguar II	Bonanza*	Excalibur*	Mini Mustang*	Aztec	Jaguar III*
	Rebel III*		Shenandoah	Crewcut*	Jaguar III*	Mustang II*	Mirage	Monarch*
	Rebel Jr.*					Shortstop II*		Pedestal*
						Team Jr.*		Shenandoah
Bentgrass: Colonial		Highland	Highland	Highland	Highland	Exeter		Highland
				SR7100		Highland		
Bentgrass: Creeping	L-93	18th Green	Penncross	Dominant	18th Green	Aggressor	Penncross	18th Green
	Crenshaw	Penn G-6	Penneagle	Dominant Plus	Penn A-4	Cato	Penneagle	Brighton
	Lopez	Penncross	Pennlinks	Penn A-4	Penn G-6	Mariner	Pennlinks	Penn A-4
	Penn A-4	Pennlinks	Pennway	Penn G-6	Penncross	National	Procup	Penn G-6
	Penn A-6	Pennway		Penncross	Penneagle	Penncross		Penncross
	Penn G-6	Providence		Penneagle	Pennlinks	Penneagle		Penneagle
	Penncross			Pennlinks	Pennway	Pennlinks		Pennlinks
	Penneagle			Pennway	Providence	Pennway		Pennway
	Pennlinks			Providence	SR1020			
	Southshore			SR1020				
				SR1119				
				SRO bentgrass				
Bentgrass: Velvet				SR7200				
Poa trivialis	Laser	Winterstar		Sabre	Sabre	Colt		Sunup
	Fuzzy							Winterstar
	Snowbird							
Poa supina	Supranova							
Poa compressa		Canada Blue		Ruebens	Canada Blue			Canada Blue
					Reubens			
Weeping alkali	Salty			Fults	Salty			Salty
				Salty				

* contains endophytes

For a list of Ontario distributors of the turfgrass varieties listed in this publication, see *Table 5-4. Ontario distributors of turfgrass varieties.*

Table 5-4. Ontario distributors of turfgrass varieties

Company	Address	Telephone	Fax
AgriBioTech Canada, Inc.	250 Baseline Rd. East Bowmanville, ON L1C 1A4	(888) 768-4935 (905) 623-2660	(905) 623-6127
Bishop Farm Seeds Ltd.	Box 338, Belleville, ONT K8N 5A5	(613) 968-5533	(613) 968-8617
Corland Seeds Ltd.	P.O. Box 336, Guelph, ON N1H 6K5	(519) 763-2059	(519) 763-5192
Graham Turf Seeds Ltd.	1702 Elm Tree Rd, R.R. #1, Lindsay, ON K9V 4R1	(705) 878-8822	(705) 878-1978
Ontario Seed Company	Box 144, Waterloo, ON N2J 3Z9	(519) 886-0557	(519) 886-0605
Pickseed Canada Ltd.	1 Greenfield Rd., Box 304, Lindsay, ON K9V 4S3	(705) 878-9240	(705) 878-9249
Parsons Seeds Ltd.	P.O. Box 280, Beeton, ON L0G 1A0	(905) 729-2202	(905) 729-2623
The Scotts Company	39 Monte Vista Trail, Brampton, ON L6Z 2J7	(905) 846-3319	(905) 839-6526
Speare Seeds Ltd.	P.O. Box 171, Harriston, ON N0G 1Z0	(519) 338-3840	(519) 338-2510

Time of seeding

Seeding can be done mid-April to early June, mid-July to end of September, or as a dormant seeding. The period from mid-August to mid-September is preferred as soil moisture and temperature conditions are optimum for germination and there is less competition from germinating weeds.

For seeding rates see *Table 5-5. Turf seeding rates.*

Table 5-5. Turf seeding rates

Species	Seeding rate per 100 m^2
creeping bentgrass	0.5–1.0 kg
Kentucky bluegrass	1.0–2.0 kg
perennial ryegrass	2.0–4.0 kg
fine fescue	1.0–3.0 kg
tall fescue	2.0–3.0 kg

Weed control

Broadleaf weeds can be a problem in newly seeded turf. Weeds such as mustard, ragweed, lamb's quarters can be controlled by mowing. Chemical control can be applied once seedlings have been mowed several times.

Mowing newly seeded turf

For Kentucky bluegrasses, fine fescues, perennial ryegrasses and tall fescues, allow about 4 cm growth before first mowing. Maintain at mowing heights as listed in *Table 5-6. Recommended mowing heights.* For bentgrasses mow after 2.5 cm growth. For the next 2–3 mowings cut at 12.5 mm, gradually reducing it to the desired mowing height.

Table 5-6. Recommended mowing heights

	Mowing Height	Clippings*
Greens	4.8–7.5 mm	remove
Tees	7.5–15 mm	remove
Fairways	13–23 mm	return or remove
Athletic Fields	2.5–5.0 cm	return
Lawns	4.0–6.0 cm	return

* Clippings contain nutrients the soil can use. If they are removed, additional nutrients, in particular nitrogen and potassium, should be increased. If turf is mowed regularly, clippings do not contribute to thatch accumulation.

APPENDIX A: Laboratories

Accredited soil testing labs in Ontario

Lab	Address	Phone *Fax*	Contacts	E-mail
A & L Canada Laboratories East, Inc.	2136 Jetstream Road, London, ON N5V 3P5	519-457-2575 *519-457-2664*	Greg Patterson Ian McLachlin	aginfo@al-labs-can.com
Accutest Laboratories	146 Colonnade Road, Unit #8 Nepean, ON K2E 7Y1	613-727-5692 *613-727-5222*	Lorna Wilson Peter Haulena	phaulena@accutestlabs.com
Agri-Food Laboratories	503 Imperial Road, Unit #1, Guelph, ON N1H 6T9	519-837-1600 1-800-265-7175 *519-837-1242*	Dale Cowan Nora Wilson	lab@agtest.com
Soil and Nutrient Laboratory (formerly Analytical Services, Land Resource Science)	University of Guelph, P.O.Box 3650, 95 Stone Road West Guelph, ON N1H 8J7	519-767-6226 *519-767-6240*		vkerslak@lsd.uoguelph.ca
Stratford Agri Analysis Inc. *(A Daco Laboratories Ltd. company)*	1131 Erie St., Box 760, Stratford, ON N5A 6W1	519-273-4411 1-800-323-9089 *519-273-4411*	Dale Peters Gary Roberts Keith Lemp	saa@dacolabs.com

Diagnostic services

Pest Diagnostic Clinic
Laboratory Services Division
University of Guelph
95 Stone Rd. W.,
Guelph, ON N1H 8J7
Phone: (519) 767-6256
Fax: (519) 767-6240
E-mail: pdc@lsd.uoguelph.ca
www.uoguelph.ca/pdc

Contact the lab office and ask for a submission form and price list.

Then, send them the completed form and samples for disease diagnosis, insect or weed identification, nematode counts and verticillium testing.

Payment

Payment (minimum $25) must accompany the form and samples.

Make cheque payable to the University of Guelph. Additional charges will be invoiced with the final report. VISA and Mastercard are also accepted. Please do not mail cash.

APPENDIX B: Collecting and submitting samples

Sampling for nematodes

When to sample
Take soil and root samples at any time when the soil is not frozen. In Ontario nematode soil population levels are generally highest in May–June and again in September–October.

Sampling pattern
If living crop plants are present in the sample area, take samples within the row and from the area of the feeder root zone (with trees this is the drip line).

Problem areas
Take soil and root samples from the margins of the problem area where the plants are still living. If possible, also take soil and root samples from healthy areas in the same field.

Sampling soil
Take samples using a soil-sampling tube, trowel or narrow-bladed shovel. Sample soil to a depth of 20–25 cm (8–10 in.). If the soil is bare, remove the top 2 cm (1 in.) before sampling. Combine 10 or more subsamples in a clean pail or plastic bag. Mix them well. Take 1/2–1 L (1 pt–1 qt) from this to create a sample. No one sample should represent more than 2.5 ha (6.25 ac).

Number of subsamples
The number of subsamples is based on the total area sampled:
- for 500 m^2 (5,400 sq ft) take 10 subsamples
- for 500 m^2–0.5 ha (5,400 sq ft–1.25 ac) take 25
- for 0.5 ha–2.5 ha (1.25–6.25 ac) take 50

Sampling roots
From small plants, take the entire root system plus adhering soil. For large plants, dig 10–20 g (1/2–1 oz) fresh weight from the feeder root zone and submit it.

Handling soil samples
Place in plastic bags as soon as possible after collecting.

Handling root samples
Place in plastic bags and cover with moist soil from the sample area.

Storage
Store samples at 5–10°C (40–50°F) and do not expose them to direct sun or extreme heat or cold.

Only living nematodes can be counted. Accurate counts depend on proper handling of samples

Submitting plants for disease diagnosis or identification
Forms can be obtained from the Pest Diagnostic Clinic. Carefully fill in all of the categories on the form. In the space provided draw the most obvious symptom and the pattern of the disease in the field. It is important to include the cropping history of the area for the past 3 years and this year's pesticide use records.

Choose a complete, representative sample showing early symptoms. Submit as much of the plant as is practical, including the root system. Or submit several plants showing a range of symptoms.

Sampling turfgrass
For turfgrass, submit a 10–15 cm square piece of turf including thatch and at least 5 cm of soil. Take the sample from the outside edge of a ring or patch and include healthy and unhealthy turf as well as the interface between. If symptoms are general, collect the sample from an area where they are of intermediate severity.

Dead plants don't work
Completely dead material is usually inadequate for diagnosis. Include at least a 20–25 cm sample of the top portion of the stem with buds, leaves, flowers or fruits in identifiable condition. Tie the root system off in a separate plastic bag so that it does not dry out and the soil does not contaminate the leaves. Wrap plants in newspaper and put them in a plastic bag.

Do not add moisture, as this encourages decay.

Cushion specimens and pack them in a sturdy box to avoid damage during shipping.

Do not leave specimens to bake or freeze in a vehicle or in a location where they can deteriorate.

Delivery

Deliver samples to the Pest Diagnostic Clinic as soon as possible by courier at the beginning of the week.

Submitting insect specimens for identification

Place dead, hard-bodied insects and spiders in vials or boxes and cushion them with tissues or cotton.

Place soft-bodied insects and caterpillars in vials containing alcohol. Do not use water as they will rot.

Do not tape the insects to paper or send them loose in an envelope.

Place live insects in a container with enough plant "food" to support them during transit. Be sure to write "live" on the outside of the package.

APPENDIX C: Ontario Ministry of Agriculture, Food and Rural Affairs Advisory Staff

Nursery and landscape advisory services

Jennifer Hobson
OMAFRA Nursery Crop Specialist
Edmund C. Bovey Building
University of Guelph, Guelph, ON N1G 2W1
Phone: (519) 824-4120 x 2671
Fax: (519) 767-0755
email: *jhobson@omafra.gov.on.ca*
www.gov.on.ca/omafra/english/crops/hort/nursery.html

Turfgrass advisory services

Pam Charbonneau
OMAFRA Turfgrass Specialist
The Guelph Turfgrass Institute
328 Victoria Rd. South, Guelph, ON N1H 6H8
Phone: (519) 824-4120 x 2597
Fax: (519) 766-1704
email: *pcharbon@omafra.gov.on.ca*
www.gov.on.ca/omafra/english/crops/hort/turf.html

Our Agriphone service

1-888-290-4441

For weekly insect and disease updates and cultural recommendations for woody landscape plants and turfgrass call the above number. Available April through October this service is accessible 24 hours a day 7 days a week.

Our Agrifax service

Tired of jotting down the weekly agriphone message? Once a week you can receive a printed copy of either or both agriphone reports by fax or email from April though October. A subscription fee of $25.00 for each report per season applies. To order call 1-888-4-OMAFRA.

APPENDIX D: Ontario Ministry of Environment Pesticides Control Offices

Region and county	Pesticides officer	Address	Telephone
Central region Toronto, Halton, Peel, York, Durham	Charles Zubovits	5775 Yonge St, 8th Floor Toronto, ON M2M 4J1	(416) 326-3671 1-800-810-8048 fax (416) 325-6347
West-Central Region Haldimand-Norfolk, Niagara, Hamilton-Wentworth, Dufferin, Wellington, Waterloo, Brant	Paul McCubbin Linda Gabriele	Ontario Government Building 119 King St. West, 12th Floor Hamilton, ON L8P 3Y9	(905) 521-7667 (905) 521-7658 fax (905) 521-7820
Eastern Region Frontenac, Hastings, Lennox & Addington, Prince Edward, Leeds & Grenville, Prescott & Russell, Stormont/Dundas & Glengarry Peterborough, Victoria, Northumberland, Renfrew, Ottawa-Carleton, Lanark, District of Nipissing (Twsps of Airy, Murchison, Dickens, Lyell and Sabine)	Andrew Morley	133 Dalton Avenue P.O. Box 820 Kingston, ON K7L 4X6	(613) 549-4000 ext 2684 fax (613) 548-6908 1-800-267-0974
Southwestern Region Elgin, Middlesex, Oxford, Essex, Kent, Lambton, Bruce, Grey, Huron, Perth,Simcoe	Doug Morrow Wray Lampman	659 Exeter Road, 2nd Floor London, ON N6E 1L3	(519) 873-5047 (519) 873-5048 fax (519) 873-5000
Northern Region Manitoulin, Nipissing, Parry Sound, Sudbury, Algoma East, Cochrane East, Haliburton, Muskoka, Kenora, Rainy River, Thunder Bay, Algoma West, Cochrane West	Ray Potvin John Negusanti	199 Larch Street, Ste 1101 Sudbury, ON P3E 5P9	(705) 564-3247 (705) 564-3249 fax (705) 564-4180
Standards Development Branch		Pesticides Section (mailing address) 135 St. Clair Avenue West Toronto, ON M4V 1P5	(416) 327-5519 Fax (416) 327-2936
Approvals Branch		Pesticides Licensing 250 Davisville Avenue, 3rd Floor Toronto, ON M4S 1H2	(416) 440-3584 1-800-461-6290 fax (416) 440-6973

APPENDIX E. The Metric System

Metric Units

Linear Measures (length)

10 millimetres (mm) = 1 centimetre (cm)
100 centimetres (cm) = 1 metre (m)
1,000 metres = 1 kilometre (km)

Square Measures (area)

100 m x 100 m = 10,000 m^2 = 1 hectare (ha)
100 ha = 1 square kilometre (km^2)

Cubic Measures (volume)

Dry Measure

1,000 cubic millimetres (mm^3)=1 cubic centimetre (cm^3)
1,000,000 cm^3 = 1 cubic metre (m^3)

Liquid Measure

1,000 millilitres (mL) = 1 litre (L)
100 L = 1 hectolitre (hL)

Weight-Volume Equivalents (for water)

(1.00 kg) 1,000 grams = 1 litre (1.00 L)
(0.50 kg) 500 grams = 500 mL (0.50 L)
(0.10 kg) 100 grams = 100 mL (0.10 L)
(0.01 kg) 10 grams = 10 mL (0.01 L)
(0.001 kg) 1 gram = 1 mL (0.001 L)

Weight Measures

1,000 milligrams (mg) = 1 gram (g)
1,000 grams = 1 kilogram (kg)
1,000 kilograms = 1 tonne (t)
1 mg/kg = 1 part per million (ppm)

Dry-Liquid Equivalents

1 cm^3 = 1 mL
1 m^3 = 1,000 L

Application Rate Conversions

Metric to Imperial (approximate)

litres per hectare x 0.09 =gallons per acre
litres per hectare x 0.36 =quarts per acre
litres per hectare x 0.71 =pints per acre
millilitres per hectare x 0.015 =fluid ounces per acre
grams per hectare x 0.015 =ounces per acre
kilograms per hectare x 0.89 =pounds per acre
tonnes per hectare x 0.45 =tons per acre

Imperial to Metric (approximate)

gallons per acre x 11.23 = litres per hectare (L/ha)
quarts per acre x 2.8 = litres per hectare (L/ha)
pints per acre x 1.4 = litres per hectare (L/ha)
fluid ounces per acre x 70 = millilitres per hectare (mL/ha)
tons per acre x 2.24 = tonnes per hectare (t/ha)
pounds per acre x 1.12 = kilograms per hectare (kg/ha)
ounces per acre x 70 = grams per hectare (g/ha)

Liquid Equivalents

litres/hectare	*gallons/acre (approx.)*
50	= 5
100	= 10
150	= 15
200	= 20
250	= 25
300	= 30

Dry Weight Equivalents

grams or kilograms/hectare	*ounces or pounds/acre*
100 grams =	11/2 ounces
200 grams =	3 ounces
300 grams =	41/4 ounces
500 grams =	7 ounces
700 grams =	10 ounces
1.1 kilograms =	1 pound
1.5 kilograms =	1 1/4 pounds
2.0 kilograms =	1 3/4 pounds
2.5 kilograms =	2 1/4 pounds
3.25 kilograms =	3 pounds
4.0 kilograms =	3 1/2 pounds
5.0 kilograms =	4 1/2 pounds
6.0 kilograms =	5 1/4 pounds
7.5 kilograms =	6 3/4 pounds
9.0 kilograms =	8 pounds
11.0 kilograms =	10 pounds
13.0 kilograms =	11 1/2 pounds
15.0 kilograms =	13 1/2 pounds

Metric Conversions

5 mL = 1 tsp
15 mL = 1 tbsp
28.5 mL = 1 fl. oz

Conversion Tables — Metric to Imperial

Length

1 millimetre (mm)= 0.04 inch
1 centimetre (cm)= 0.40 inch
1 metre (m)= 39.40 inches
1 metre (m)= 3.28 feet
1 metre (m)= 1.09 yards
1 kilometre (km)= 0.62 mile

Area

1 square centimetre (cm^2)= 0.16 square inch
1 square metre (m^2)= 10.77 square feet
1 square metre (m^2)= 1.20 square yards
1 kilometre (km^2)= 0.39 square mile
1 hectare (ha)= 107,636 square feet
1 hectare (ha)= 2.5 acres

Volume (dry)

1 cubic centimetre (cm^3)= 0.061 cubic inch
1 cubic metre (m^3)= 1.31 cubic yards
1 cubic metre (m^3)= 35.31 cubic feet
1,000 cubic metres (m^3)= 0.81 acre-foot
1 hectolitre (hL)= 2.8 bushels

Volume (liquid)

1 millimetre (mL)= 0.035 fluid ounce
1 litre (L)= 1.76 pints
1 litre (L)= 0.88 quart
1 litre (L)= 0.22 gallon (Imp.)
1 litre (L)= 0.26 gallon (U.S.)

Weight

1 gram (g)= 0.035 ounce
1 kilogram (kg)= 2.21 pounds
1 tonne (t)= 1.10 short tons
1 tonne (t)= 2,205 pounds

Pressure

1 kilopascal (kPa)= 0.15 pounds/in^2

Speed

1 metre per second= 3.28 feet per second
1 metre per second= 2.24 miles per hour
1 kilometre per hour= 0.62 mile per hour

Temperature

°F= (°C X 9/5) + 32

Imperial to Metric (approximate)

Length

1 inch =2.54 cm
1 foot = 0.30 m
1 yard = 0.91 m
1 mile = 1.61 km

Area

1 square foot = 0.09 m^2
1 square yard = 0.84 m^2
1 acre = 0.40 ha

Volume (dry)

1 cubic yard =0.76 m^3
1 bushel = 36.37 L

Volume (liquid)

1 fluid ounce (Imp.) =28.41 mL
1 pint (Imp.) = 0.57 L
1 gallon (Imp.) = 4.55 L
1 gallon (U.S.) = 3.79 L

Weight

1 ounce = 28.35 g
1 pound = 453.6 g
1 ton =0.91 tonne

Pressure

1 pound per square inch = 6.90 kPa

Temperature

°C = (°F – 32) X 5/9

Spraying Record

Crop or field no.	Date	Material used	Rate or amount	Weather and soil conditions

Emergency and First-Aid Procedures for Pesticide Poisoning

- Become familiar with the chemicals you are using. Keep a list of common names in case of accidents or emergencies. This information can be found on the product labels and cross-referenced in this publication.
- If a pesticide has come in contact with the skin or has been spilled on clothing, remove the clothing and wash the skin thoroughly with soap and warm water.
- If pesticide has come in contact with the eyes, rinse them with plenty of clean water for 15 minutes. Repeat this procedure.
- If a person suspects poisoning from exposure to a pesticide by swallowing, inhalation, or contact with skin or eyes, read the label on the pesticide container and carry out the first-aid treatment suggested.
- **Immediately after first-aid treatment has been given, wrap the patient in a coat or blanket and rush him/her to the nearest hospital. Take the list of chemical common names with you and identify the ones being used.**
- **If a person is unconscious or lapses into unconsciousness, call an ambulance immediately.**
- **Emergency advice on pesticide poisoning is available from the Regional Poison Information Centres at:**

  Toronto 1-800-268-9017 Ottawa (bilingual) 1-800-267-1373

- **Those needing hearing assistance should call: 1-416-597-0215 (TTY)**

  Emergency telephone numbers are listed at the front of each Bell telephone directory.

  Fill in the following:

  My Local Poison Information Centre Telephone Number is:

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